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AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE HILL PUBLISHING COMPANY,

505 PEARL STREET, NEW YORK.

Vol 32. No. 1.

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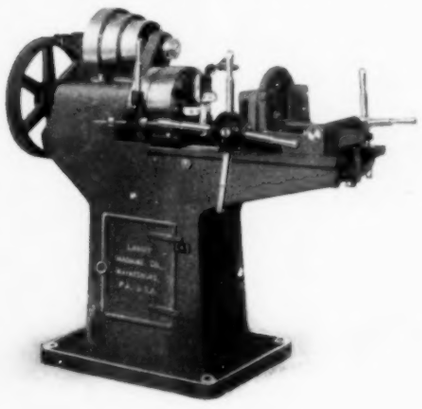

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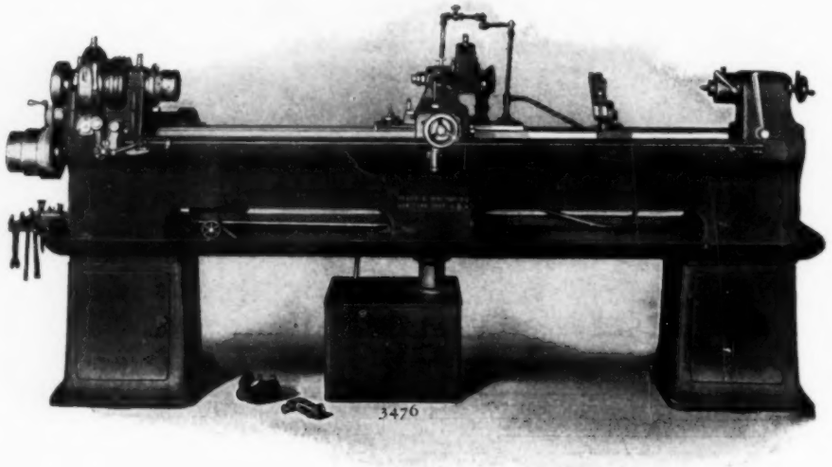

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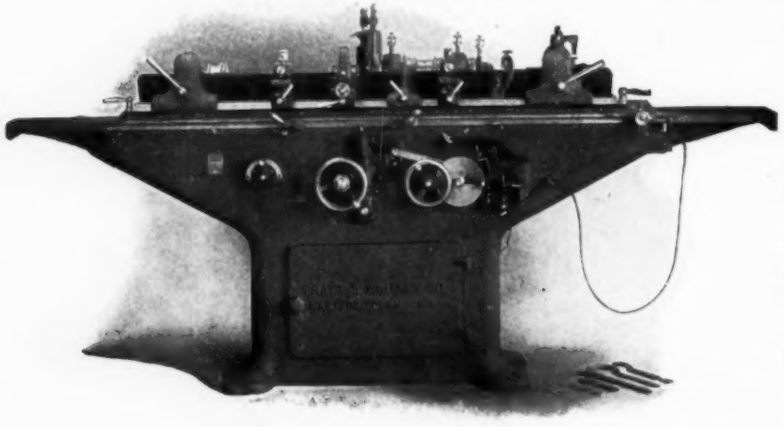

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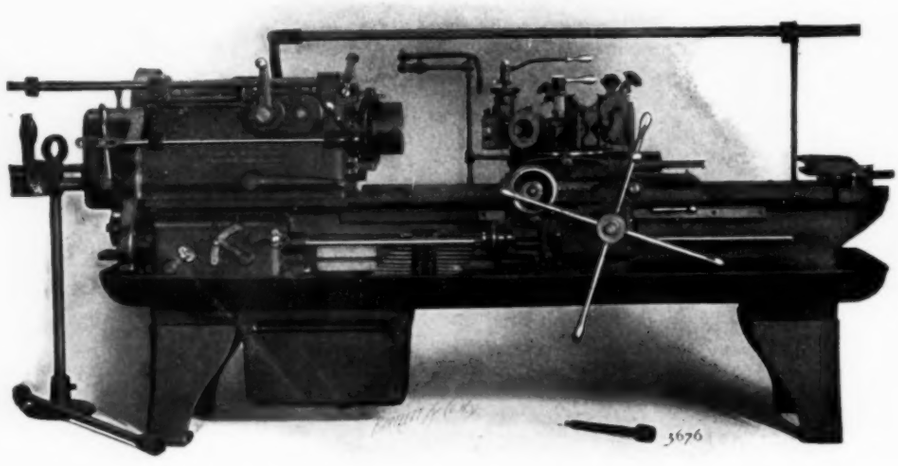

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A New High Speed Milling Cutter—I

The Development of an Inserted Blade Cutter Giving Record Breaking Results. Comprehensive Tests of Power Consumed by Milling Machines

BY WILLIAM H. TAYLOR*

Ten years ago sagacious mechanical minds predicted that when the milling machine became better developed and understood it would surpass the planer as a tool for machining large surfaces. We have now attained that epoch, for it is recognized and conceded that the process of milling is superior to all other processes of machining metal by reason of the fact that metal can be removed at a much higher rate of speed than is possible with any other method of machining. Milling cutters are made up of a multiplicity of cutting edges, and as the operation of cutting is continuous, work can be machined at a much lower time cost.

Organization and system have triumphed and brought innovations in shop practice and more attention has been paid to designing the parts to be machined so as to adapt them to special types of machine tools which guarantee high economies over the time heretofore consumed in handling, setting and machining. Because of the introduction of these improved shop methods it has been necessary to practically redesign many machine tools. The heavy, high-powered milling machine has met with favor as the range of work handled by it has been greatly extended. The older type of low-powered machine was hardly rigid enough to withstand the strains imposed by the ordinary carbon-steel cutters, but the modern high-powered machine, used in connection with high-speed steel milling cutters, has taken precedence over the planer in many instances, making it possible to show considerable saving by removing the surplus metal from forgings rather than forging closer to the finished sizes.

The advent of high-speed steel impelled the builders of milling machines, especially those of the planer type, to offer high-powered milling machines, and today it is not an uncommon thing to see a milling machine whose spindle is driven by an individual motor of from 50 to 75 horsepower capacity, whose platen is operated by an independent motor of from 7 to 15 horsepower capacity, and whose cross-rail is raised and lowered by an individual motor of from 3 to 5 horsepower capacity.

Undoubtedly exception will be taken by those not familiar with the practice, to the advocacy of high-powered machines, citing the cost of power required to operate the machine as extravagant. But those given to careful investigation will find that the power required to remove a cubic inch of material with a high-powered machine will be much lower than with the lesser powered machine and that the gain in feed and speed will more than compensate for any additional expenditure in power. Those who have investigated shop costs find that power is not the potent factor to be given consideration, but rather time, wages and overhead charges.

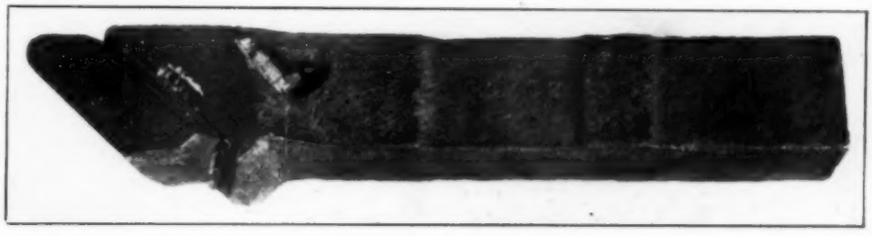


FIG. 2. INSERTED HIGH-SPEED STEEL CUTTER ANCHORED IN NICKEL-STEEL HOLDER BY A TYPE METAL ANCHORAGE. USED IN THE HEAD OF A ROTARY PLANER FOR MILLING KRUPP ARMOR PLATE

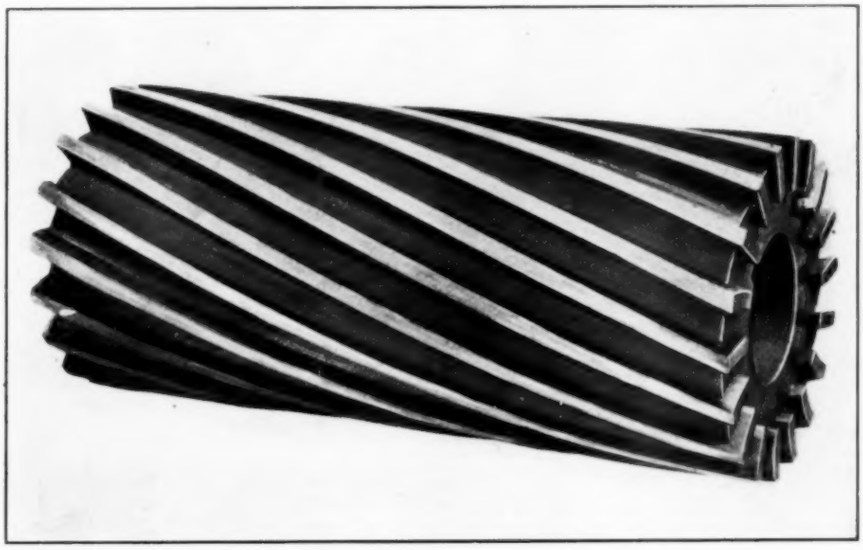


FIG. 1. FIRST MILLING CUTTER WITH INSERTED HIGH-SPEED STEEL BLADES WITH WHICH ALL THE TESTS WERE MADE

The cutter has been in use intermittently for eight months. It has been ground but six times and the original equipment of blades is still intact. Diameter 8 inches, face 18 inches, bore 3½ inches, 18 blades.

The Machine Now in Advance of the Cutter

While the milling machine has been developed toward a rigid, high-speed and high-powered machine the milling cutter has not advanced as rapidly; consequently the user is confronted with a very unsatisfactory condition—the output of his machine being limited by the capacity of the cutters. This condition results from design, the fault lying in the shape, the method of securing and the method of treating the blades so as to develop the proper degree of hardness.

The purpose of this article will be to point out what has been accomplished in slab milling by the use of a milling cutter with inserted high-speed steel blades, so constructed as to possess a capacity in excess of the requirements of the modern heavy high-powered milling machine. By dissecting each element and comparing it graphically with the prevailing practice the reader will be enabled to discern why certain adopted features, substantiated by actual practice, are so effective, economical and efficient.

Development of the Inserted-blade Type of Milling Cutter with Blades Bent to Form a Helix and Secured by Soft Metal

From careful investigation I find that

*The Tabor Manufacturing Company.

the first successful development of an inserted-blade type of milling cutter was made by George Bechtol in 1892. He conceived the idea of bending carbon-steel blades to form a helix. His cutter consisted of a malleable-iron core, which was bored and keyseated and into whose body were planed eight helical dovetail grooves considerably wider than the blades. His method of planing the helical grooves was quite unique; the core was placed between a pair of planer centers and a bar clamped to one end extended across the platen at right angles to the work and rested on another bar, one end of which was clamped to the housing and the other to the bed at the desired angle. The bar attached to the work was kept in contact with the latter bar by means of a suitable weight on its outer end. As the platen traveled back and forth the bar attached to the work slid along the top of the bar attached to housing and on account of its inclined position forced the work to make a partial revolution with each stroke of the planer. After bending the blades around an arbor to the desired helix he set them inside a cylinder and properly spaced them by means of blocks. The core was then set in a central position with the grooves matching up with the blades and soft metal poured in, filling the dovetail grooves and spaces between the blades. By this method the blades were submerged in a soft-metal housing carried on a hard-metal core. The results obtained with this cutter were, at the time, considered extraordinary, being far in advance of those obtained with other types of carbon-steel cutters. The diameter of these cutters was 5 inches.

This type of cutter again made its appearance seven years later, manufactured by a Newark concern and illustrated and described in the AMERICAN MACHINIST for April 13, 1899.

In the interim high-speed steel made its appearance, conditions had changed, and manufacturers hesitated to embark in this field of improvement because they knew it meant large expenditures for experiments with a strong possibility of failure. The more adventurous did make experiments but their results never became a matter of public record, and, up to the present time, the construction of the inserted-blade type of high-speed cutter has not changed, straight blades being employed and secured by various mechanical means.

THE WORK OF C. D. PECK

C. D. Peck was the first man to successfully develop an innovation in high-speed milling cutters of the inserted-blade type for heavy slab milling. His blades were helical in shape and made of high-speed steel. The paramount features in the construction of Mr. Peck's cutters were the helical shape of the blades and his methods for bending and treating the blades so they would maintain their shape, and the proper degree of hardness, and be dependable when subjected to extra heavy service.

To construct his cutter Mr. Peck planed

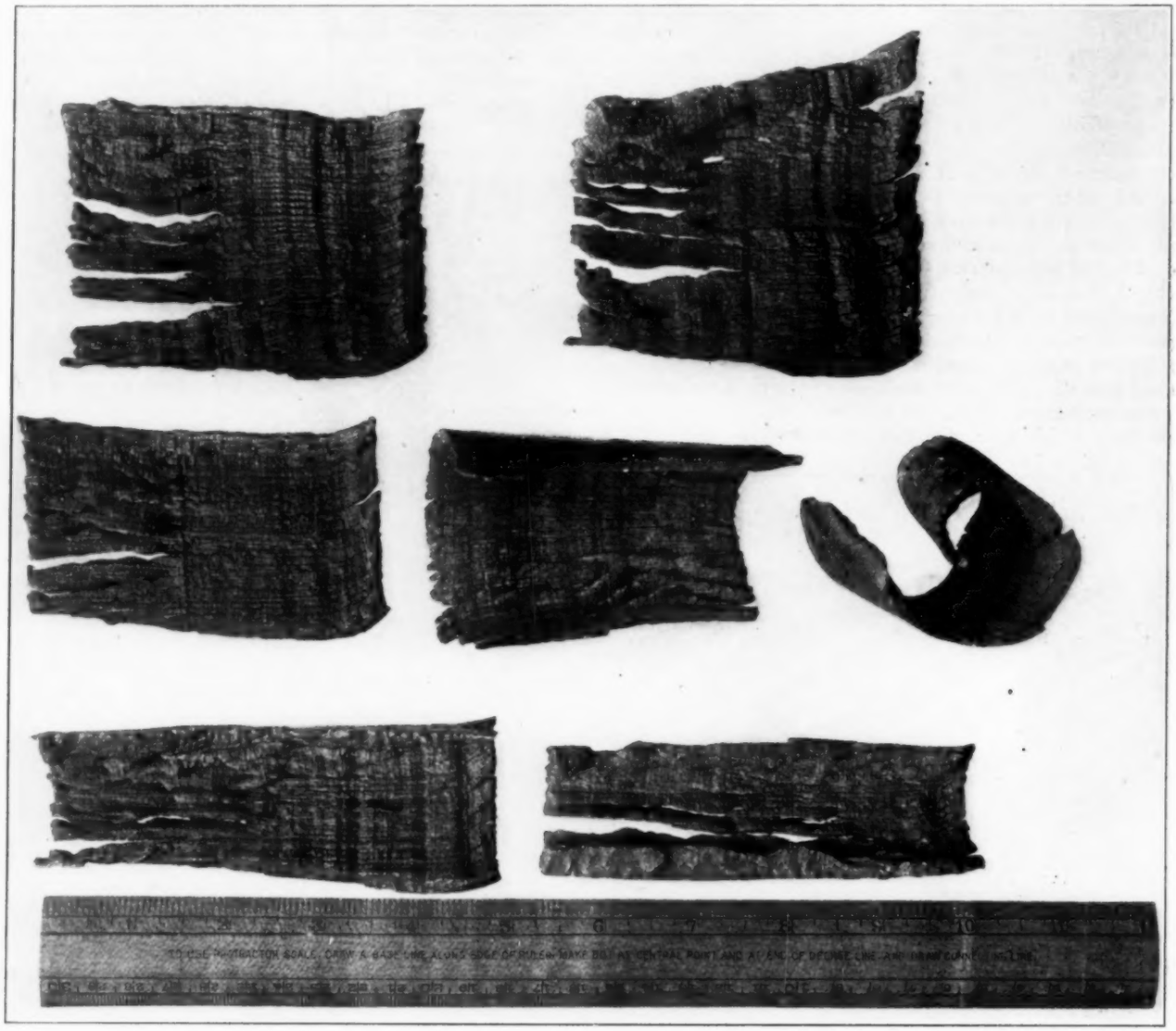


FIG. 3. CHIPS TAKEN WITH TOOLS SHOWN IN FIG. 2 FROM KRUPP ARMOR PLATE OF 1.20 TO 2 PER CENT. CARBON. WEIGHT OF CHIPS SHOWN 3¾ POUNDS

helical slots, rectangular in shape, in a steel housing, inserting therein high-speed steel blades bent to fit the helix of the slots and holding them in a rigid position by means of steel wedges inserted at intervals between the front face of the blades and the side of the slot, filling the spaces between the wedges with soft metal. Mr. Peck designed and built a hand press for bending the blades which consisted of a pair of lateral jaws encircling a shaft, one stationary and the other actuated by means of a lever and set screws, so as to close upon the blades and form a helix.

His first cutter was built at the Pittsburg works of the American Locomotive Company in 1905, and tests made at the time gave results far in excess of the results obtained from other types of milling cutters with inserted blades, both in the amount of material removed in a specified time and for the amount of power consumed per cubic inch of material removed. He proceeded to build more cutters and put them into service, having demonstrated by continuous operation that the capacity of these cutters for removing metal was not only far greater than that of other types of inserted-blade cutters, but was also in excess of the capacity of the modern type of high-powered milling machine. His first continuous heavy milling, which exceeded all previous records, was made early in 1907 on a heavy Newton slab milling machine, a cut of 9½ inches wide and 9/16 inch deep with a table feed of 8 inches per minute being taken on a pair of locomotive connecting-rod forgings of 0.54 carbon steel. This was removing metal at the rate of 43 cubic inches per minute.*

Early in 1907 Mr. Peck had a conference with the manufacturers of the Taylor-Newbold cold saw, who were developing a milling cutter of the inserted-blade type, the conference resulting in Mr. Peck turning his developments over to the Taylor-Newbold people. It was from this combination of development that the milling cutter about to be described was evolved.

The Work of Taylor and Newbold

Having described what Mr. Peck accomplished as his share of the milling cutter's development, I shall briefly describe what Messrs. Taylor and Newbold had accomplished as their share of the development up to the time of joining forces with Mr. Peck.

The use of soft metal, such as type metal, for an anchorage to secure various forms of high-speed steel cutters in holders was originated by F. W. Taylor and S. Newbold and first applied to an ingot parting tool at the works of the Bethlehem Steel Company on February 23, 1899. Primarily this test was made to determine whether this method of securing cutters would prove practical for an inserted-tooth cold saw which was being developed by these gentlemen. These cutters were fitted to an ingot lathe and a feed of 1/10 inch was used on ingots ranging from 4 to 6 feet in diameter made of open-hearth steel, containing 3¼ per cent. nickel and from 0.40 to 0.50 per cent. carbon. The ingot was rotated at a peripheral speed of 20 to 25 feet.

Further tests were made in May and June of the same year with cutters of a different type and fitted in the head of a rotary planer where the conditions under which the cutters were to operate would be much more severe than those of the ingot lathe.

Fig. 2 shows the construction of these cutters. The milling head was 91 inches in diameter and provided with 42 inserted cutters, and carried on a hollow spindle 28 inches outside diameter and 16 inches inside diameter. The machine was designed to face heavy protective Krupp armor plate, 1.20 to 2 per cent. carbon, 12 inches thick. The average amount of excess metal to be removed from each side was from 3 to 14 inches. The results obtained from the tests were as follows:

Revolutions of spindle	1	per minute
Cutting speed	23.5	feet
Depth of cut	3	inches
Length of cut	12	"
Feed per cutter	0.05	"
Feed per revolution	2.10	"
Cubic inches per minute	75.6	"
Cubic inches per hour	4536	"
Pounds per minute	21.41	pounds
Pounds per hour	1285	"
Power required (approximately)	125	H. P.

A comprehensive idea of the size of the chips may be obtained from Fig. 3.

As far as actual performance was concerned the soft metal demonstrated itself as a highly efficient and economical means of securing cutters in holders.

To determine what pressure the soft-metal anchorage would withstand the holders and cutters were taken to the physical laboratory and subjected to 102,000 pounds pressure, and in every instance either the holders or high-speed steel cutter was broken with no perceptible disturbance of the soft-metal anchorage.

FIG. 4. HIGH-SPEED STEEL BLADE BENT TO HELICAL SHAPE WITH CURVED SIDES AND TREATED BY THE TAYLOR-WHITE PROCESS READY FOR INSERTION IN THE HOUSING

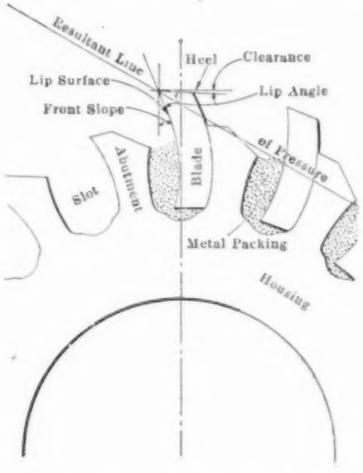


Fig. 5. Definition of terms: Housing (body of cutter), abutment (support of blade), metal packing (anchorage), slot, blade, heel of blade, clearance angle, lip angle, front slope, lip surface and resultant line of pressure. The side slope is defined by the angle of the helix.

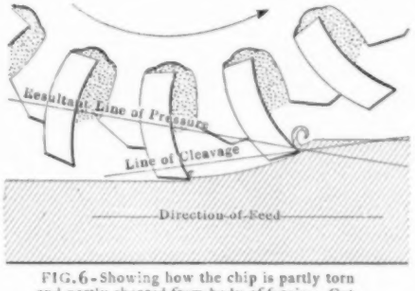


FIG. 6-Showing how the chip is partly torn and partly sheared from body of forging. Cutting edge of blade not under heavy pressure.

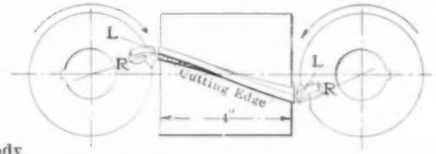


Fig. 7. Showing a constant lip angle L throughout the entire length of the blade which is set at angle of 20 degrees to an axial plane. By reason of the blade's curvature this angle remains constant throughout any length.

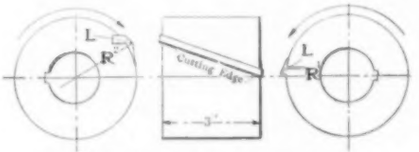


FIG. 8-Showing a varying lip angle, L, from maximum at line R^1 to a minimum at line R^2 in a straight blade set at an angle of 20 degrees to an axial plane. This condition limits the length of the blades.

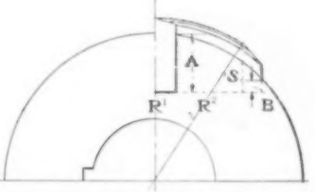


Fig. 9. Showing the development from no front slope to a positive front slope S due to a straight blade set in a plane radiating from the axis and carried across the face of the housing at an angle of 20 degrees to the axial line.

*Full particulars of this work and of the machine on which it was done will be found on page 47, Vol. 30, Part I.—Ed.

Having demonstrated that soft metal possesses all the qualifications necessary to make an ideal anchorage by which to secure various types of cutters in holders, it was adopted as the best method of securing the teeth in holders for the Taylor-Newbold saw. As the success of this saw is a matter of public record no hesitancy was felt in employing the soft-metal anchorage as the best means of securing the blades in the milling cutter.

Prevailing Practice Governing the Construction of the Inserted-blade Type of Milling Cutter

In the primary investigations it was found that there existed no standard or suitable rule governing the construction of milling cutters with inserted blades, nor is there any record of exhaustive tests having been made to determine the most effective pitch, proper clearance angles, front slope and lip angles to be employed, these functional elements being apparently arbitrary selections made to suit individual tastes.

It was also found that in constructing milling cutters with inserted blades, the prevailing practice consists of cutting rectangular slots in a cylindrical housing, with the slots lying in a plane angular to the axis. The angle at which the plane is set from the axis varies from 5 to 25 degrees according to the length and diameter of the housing. The blades are straight pieces of high-speed steel and after inserting them in the slots are ground off until a definite projection from the housing along the cutting edge is attained, when by backing off clearance is obtained.

The blades are held in position by various methods, such as clamps placed between each alternate pair of blades and drawn inward by screws; or by cutting grooves in the abutment between each alternate pair of blades which, by means of taper screws, force the parted abutments to clamp the blades on either side; or by driving wedges between the front face of the blade and the side of the slot; or by numerous other means.

We also found that much can be learned from the development of the lathe tool, especially the round-nose tool, applied to milling-cutter blades. This fact is ignored in the manufacturer of milling cutters, which are made with a straight blade inserted in a slot with its front face in a plane angular to an axis, thereby attempting the impossible—to develop and maintain throughout its length the proper front slope and lip angle and to define a helix on the line of the cutting edge.

Essential Points Given Consideration in Constructing a High-speed and High-power Milling Cutter

The first point given consideration in constructing the cutter about to be described was the shape of the blade, and the conclusions were: To maintain a prescribed slope and lip angle throughout its entire length the blade must be bent so as to form a helix, and by so shaping it all angles and contour of both blades and slot would be constant over their entire lengths. Then again with the blades helical in shape, a continuous cutting edge with a constant lip angle would be maintained throughout any length of cutter.

The second point given consideration was the pitch or lead of the blade and from experiments made with various leads, it was found that the most effective angle for the helix was about 20 degrees. To facilitate ease in computation, we adopted the formula:

$$(\text{diam.} \times 9 = \text{pitch})$$

which would develop 19 degrees and 15 minutes as the angle of the helix.

The third point to receive consideration was the number of blades to be employed. In the early stages it was considered good practice to construct milling cutters with as many teeth as possible, it being obvious that the spacing between the teeth should be enough to admit of the emery wheel grinding one tooth without touching the next one, but experience has shown that cutters having a large number of teeth do not produce the best results.

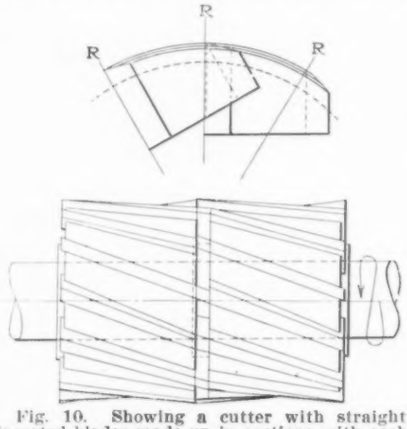


Fig. 10. Showing a cutter with straight inserted blades made up in sections with each alternate blade overlapping the blades in the opposite section, so as to obtain the desired width of face. The sections are so set that the cutting edges form a continuous line. Above the cutter is a diagram showing the relation the blades in one section bear to the blades in the other.

With inserted-blade cutters the number of blades is limited by the methods employed to secure them. In the experiments with these cutters it was found that, for heavy milling, a comparatively coarse pitch under a heavy feed will practically distribute the load evenly per blade irrespective of any eccentricity due to grinding, and that the load per blade, in pounds pressure per inch of width, is the potent factor governing the number of blades to be employed, and an equally important factor is sufficient space between the blades to allow for the free curling of the chip. When performing the function of milling, a helical shaped blade rolls the chip into a cylinder as it is sheared from the forging.

The selection of a proper number of blades is based on the following conditions: The blades must be sufficiently thick to withstand extra heavy pressure, and the space between the blades must be enough to permit of a free curling of the chip. With these conditions given due consideration, the following quota of blades was determined for the diameters given:

Cutters 4 inches nominal diameter, 14 blades
2 inches maximum bore.
Cutters 6 inches nominal diameter, 16 blades
3 inches maximum bore.
Cutters 8 inches nominal diameter, 18 blades
4 inches maximum bore.
Cutters 10 inches nominal diameter, 20 blades
5 inches maximum bore.

The maximum bore for this type of cutter was also determined as one-half of the nominal diameter, leaving the shell of the housing sufficiently strong to withstand any load imposed by an arbor fitting the maximum bore.

The fourth point to receive consideration was the overhang of the blades. In carrying out the experiments a cutter was constructed having a single blade which was subjected to extra heavy cutting pressure to determine, primarily, the strength of the anchorage and, secondarily, the distance the blade should project from the housing so as to secure a combination of the requisite strength with the greatest permissible number of grindings.

It was found that a blade projecting one and a half times its thickness would be secure against breaking under extra heavy pressure (on a ⅜-inch thick blade 4000 pounds per inch of width of face) and that the helical shape and curvature of the blade materially assisted in strengthening it.

The fifth point for consideration was the formation of the grooves in the cutter blank. This had been previously planned approximately rectangular in section with a slight amount of undercutting to hold the blade and the wedges used for fastening it in place. It appeared, however, that this grooving of the cutter blank could be done better and faster by milling than by planing, and that an undercut groove might be produced at once by a saw set in a certain relation to the cutter blank. This possibility was soon demonstrated to be practicable and although the groove so formed was not so easily fitted with a cutter blade on account of its curved sides, nevertheless it was found, as anticipated, that the curved sides gave a lip angle to the cutter which was of great value in actual service. To form the blades accurately to the shape of the groove, it was necessary to design a bending machine of great power capable of squeezing the blades at once to proper form, not only as helices of correct pitch, but also of correct curvature in a direction normal to the helix, as shown in Fig. 4.

This machine was made to act in one way like the original hand-bending machine made by Mr. Peck, but in addition

to the lateral jaws which closed upon the blade to form the helix, it was provided with a cap which snapped quickly upon the lateral jaws to completely inclose the blade being bent to proper form. Time is such an important element in the handling of high-speed steel that the value of this bending machine, quick enough in its movements to act before the temperature of the steel had fallen below the working point, can hardly be overestimated.

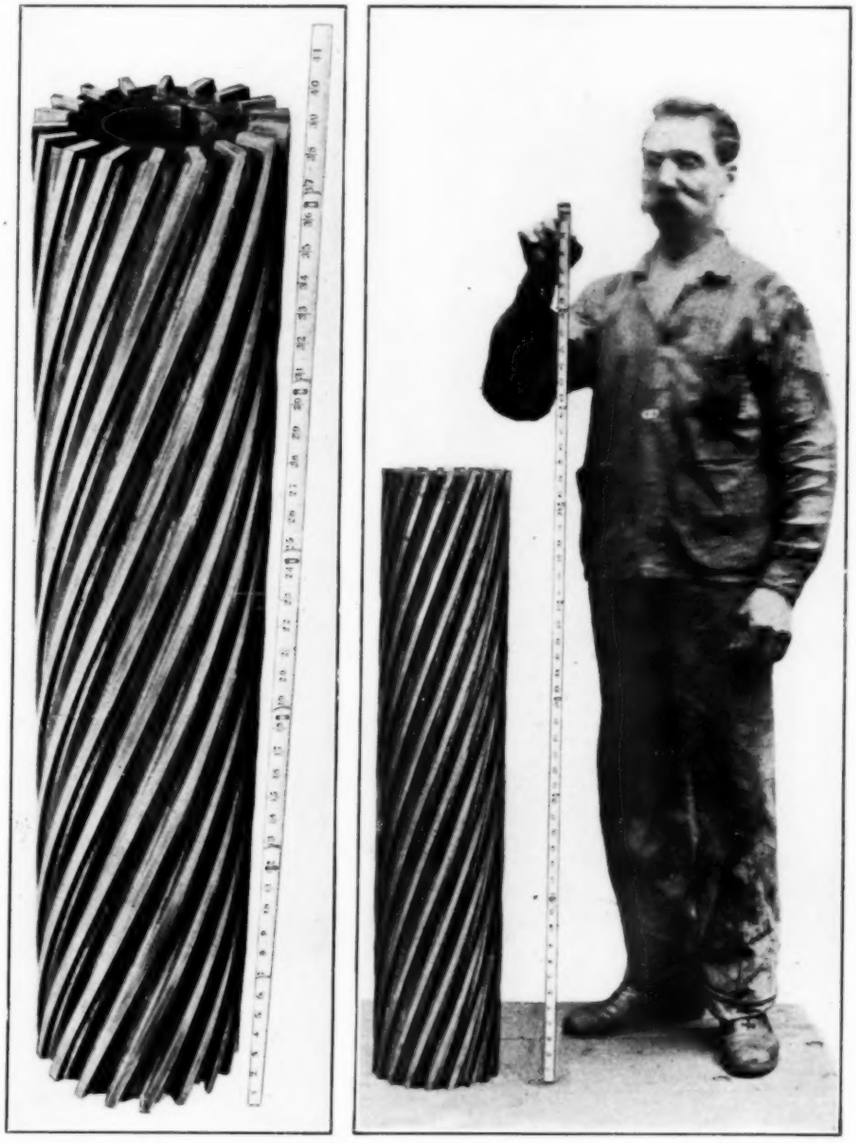


FIG. 11. THE LARGEST INSERTED BLADE SLAB MILLING CUTTER WITH CONTINUOUS CUTTING EDGES. TO BE USED BY THE NATIONAL TRANSIT COMPANY FOR FACING VALVE FLANGES, ETC. DIAMETER 8 INCHES, LENGTH 38 INCHES, BORE 3½ INCHES, 18 BLADES

Special furnaces for treating our blades under the Taylor-White patents were designed and built, but the results obtained are now of more interest than the apparatus required for manufacturing.

The sixth point to receive consideration was the method of securing the blades. From Mr. Peck's experiments it was clear that metal wedges as a means of securing the blades were not satisfactory or economical. While they could be installed with ease they were exceptionally hard to remove when necessary to replace blades, owing to their tendency to imbed themselves in the housing. Furthermore, driving them in at intervals along the high-speed steel blades developed intermittent tension causing the blades to crack and spall off at the point of contact between wedges and blades when under cutting pressure. Other mechanical fastenings were barred either by excessive cost or their inability to withstand vibration and remain rigid.

Experiments were made with various alloys until a proper combination capable of flowing freely, of cooling without shrinkage, of withstanding great strains without crumbling and of being removed quickly and economically was obtained.

A device for compressing the alloy in the slots after it had been poured was designed, as was a device for removing the alloy when replacement of blades is necessary. With the alloy compressed in the slots the blades are secured in an anchorage sufficiently rigid as to allow the blades to be broken off by sheer force without affecting it. This form of construction makes it possible to produce a cutter of moderate diameter free from torsional strains with an increased number of blades for a given diameter, and possessing a capacity in excess of the requirements of high-powered milling machines.

Definitions of Terms Used in Construction and the Weak Points Existing in Other Types of Inserted-blade Cutters

In this paper the milling cutter in question will be referred to as a helical, not a spiral cutter. The prevailing practice is to use the terms helical and spiral as synonymous. Geometrically they are not even analogous. Our experiments have conclusively shown that the closer the center of pressure of the chip is to the cutting edge, the greater its intensity and the heat generated is much more concentrated toward the cutting edge, where the sectional area that must carry off the heat is much less. Then again the frictional heat generated by lack of back slope becomes so great as to cause cohesion between the chip and the cutting edge. Under heavy pressure we have seen a compact of chip and blade which was virtually inextricable and when disunited from the blade the cutting edge still adhered to the chip. To eliminate this condition where straight blades are employed the practice is to set the front face of the blade slightly back of a radial plane (see line R^1 in Fig. 9) to assure a front slope. It is a well known fact that the absence of front slope eliminates any proclivity which the lip may have to develop a line of cleavage and thereby throw the pressure of the chip back on the lip surface from the cutting edge.

Referring to Fig. 9, when performing the functions of milling, a blade with the irregularity of front slope causes the cutter to drag on one side and gouge on the other side. Blades of this type cause excessive vibration to the cutter due to the varying angle of the front slope and necessarily consume more power. It has been contended that to alleviate the tendency of the blade to gouge and drag, and to define a more even pressure throughout the line of the cutting edge, the blades should be nicked, the assumption being that less power is required due to the breaking up of the chip than would be consumed by a continuous cutting edge producing a continuous chip.

I differ from this contention for it has been demonstrated by experiments that the initial fault is caused by absence of front slope and that by nicking the blades introduces an undesirable feature in that the blade behind a nick and whose cutting

edge covers the gap formed by a nick in the blade preceding it must accept double the feed which causes chatter and produces an uneven machined surface.

It will be also noted that when a rectangular slot is cut in the face of a housing at an angle of 20 degrees to an axial plane, its depth becomes gradually less as it progresses across the face until it reaches a point where it vanishes, as designated by lines *A* and *B*, Fig. 9. This condition not only limits the width of the cutter and necessitates a housing of large diameter when a medium width of cutter is required, but develops an anchorage which possesses the required strength and rigidity at one side and decreases in proportion to the blade's length at the other side. Where a wide face is required it is necessary to construct a cutter composed of a number of sections, as shown in Fig. 10.

Machine Work in the Rambler Automobile Factory

By Ethan Viall

In discussing the work of any large shop, with someone familiar with it, we often ask how they do certain jobs, and if, as frequently happens, they do them in practically the same way as we do, it is a source of considerable satisfaction to thus have our methods confirmed, while on the other hand, if their way is different, it is up to us to find out who is ahead of the procession.

It is for this reason, if for no other, that it is a good thing to show how work is done in a factory that has the reputation, in its particular line, that the Thomas B. Jeffery Company has, for while many of their methods may not be new to some of the readers, yet they represent the shop practice of one of the leading automobile factories where speed, economical production and commercial accuracy are vital parts of the system.

However, in the Jeffery shop, strength and durability are never sacrificed for the sake of cheapness of production, a striking example being in their making

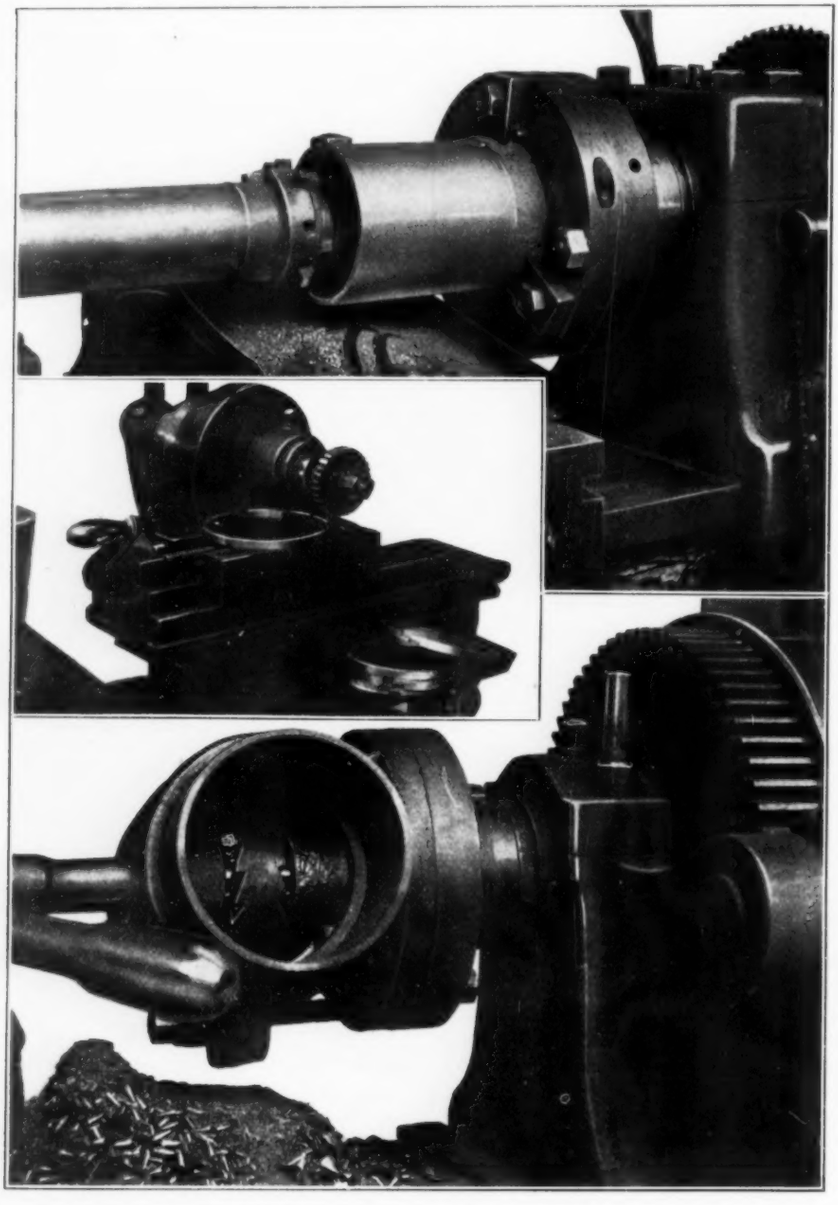
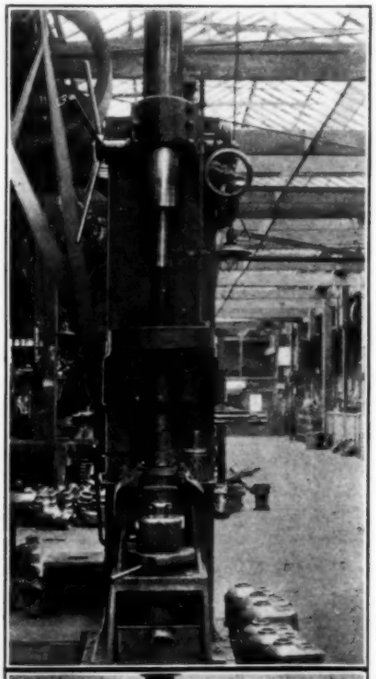


FIG. 1. TURNING AND BORING PISTON RINGS FIG. 2. MILLING THE ENDS OF RINGS
FIG. 3. FACING THE INSIDE HUBS



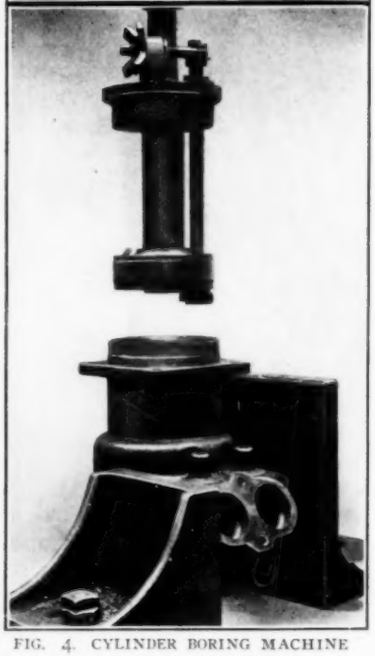


FIG. 4. CYLINDER BORING MACHINE
FIG. 5. THE COUNTERBORING TOOL

expensive dies and using bessemer steel for the drop forging of many of the small parts that are commonly made of malleable castings. As one of the factory men said: "A malleable casting might do, but a drop forging will do."

As a rule, one of the first things a mechanic wants to know is how an automobile factory machines its pistons rings, for almost every factory has a method

of its own. Some turn them eccentric and some concentric, while others bore them out, and others leave the inside rough.

Piston Rings and Cylinders

In the Jeffery shop, piston-ring blanks are cast with three lugs on one end in the usual way. The blank is first placed on an expanding mandrel and these lugs faced off. They are then placed on the special face plate shown in Fig. 1, and the outside turned.

The blank is then set eccentric by shifting over the face plate, which is arranged purposely for this, and the inside bored out. A gang tool then cuts off all the rings at one setting, and they are then put into the milling-machine vise and split as shown in Fig. 2. They are then finished by grinding both on the sides and periphery. The piston is machined and the grooves cut in the ordinary way.

Fig. 3 shows how the bosses on the inside of the piston are faced off in the turret lathe and also shows the jig used for holding the piston.

The engine cylinders are rough-bored in a special boring machine made by the Jeffery company, which is shown in Fig. 4.

There are a number of these machines in constant use. They are automatic in action and the construction of the cylinder, and the position in which it is held, allow the cutting tools to work entirely free from chips as they drop down into the pan under the cylinder.

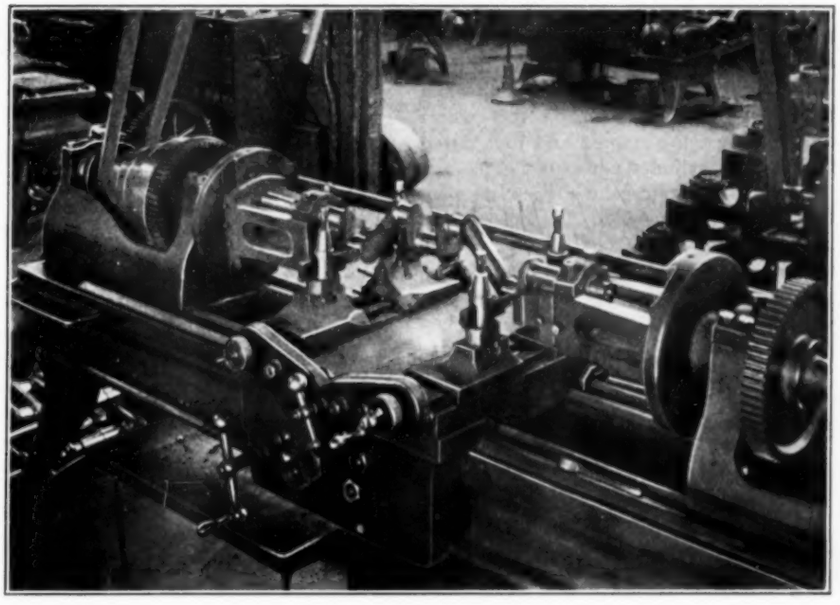


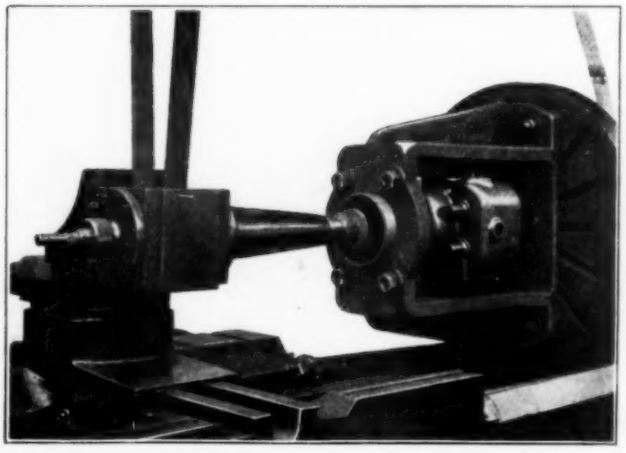
FIG. 10. A CRANK-SHAFT LATHE

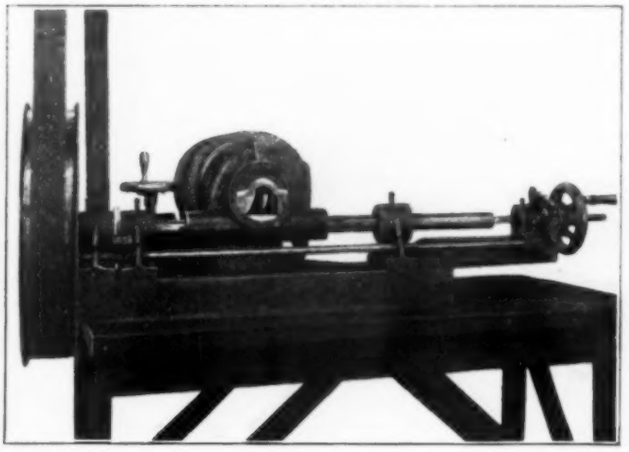
Counterboring

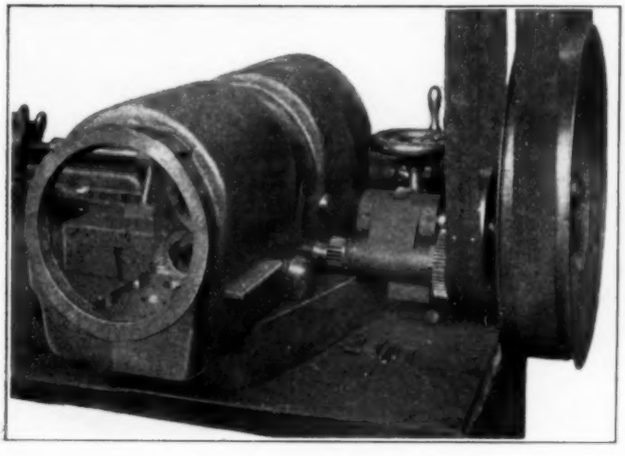
Fig. 5 shows the tool used in a drill press for cutting the clearance groove in the bottom of the cylinder.

The bar which carries the cutter has a short arm or crank at the upper end which is operated by the star hand wheel.

As the drill spindle slowly revolves this







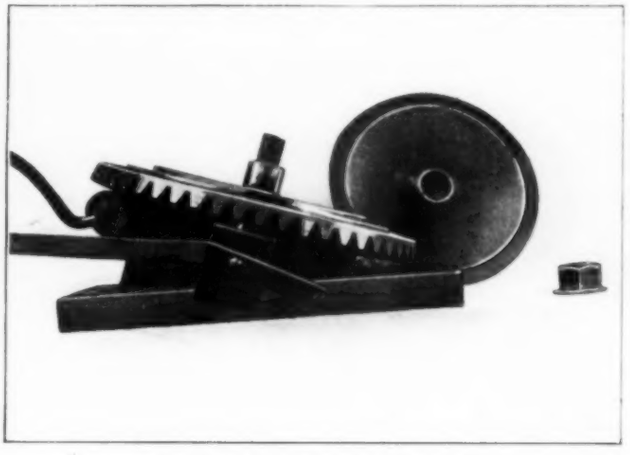


FIG. 6. GRINDING THE CYLINDERS
FIG. 7. A SPECIAL MILLING MACHINE

FIG. 8. BORING THE LONG BEARING
FIG. 9. INDEXING WITH A GEAR

star-wheel is struck with the fingers and this turns the cutter-bar and gradually forces the cutter into the metal, a little deeper at each turn, until finished, when the drill-press is stopped, the wheel screwed back, the spindle and tool raised and another cylinder put into the jig.

After the cylinders have been roughed out, they are allowed to "season," awhile and are then ground out. This grinding is done on several well known machines, but one that gives very satisfactory service, in every way, was built in the shop and is shown in Fig. 6. The heavy construction of this attachment which is used on a lathe is plainly shown.

A Special Milling Machine

A special machine for milling off two small bosses on the crank cases is shown in Fig. 7. As will be seen in this, the cutter spindle may be raised or lowered by turning the hand-wheel shown between the belt pulleys and the crank case. Were the bosses the same hight a single cutter could be used, but as they are not, this arrangement was designed and made for the purpose.

This machine is also arranged for boring out a long bearing on the crank case as shown in Fig. 8. In this cut the boring-bar is shown in position without the cutters in place.

The feeding of the boring-bar is done by the mechanism at the right, which consists principally of a feed screw, turned by a ratchet-wheel and dog, operated by the rod running parallel to the boring-bar and which is actuated by means of a crank and an eccentric on the spindle that turns the boring-bar. This crank and eccentric are shown at the left.

Roughing Crank Shafts

Fig. 10 shows a lathe which has been made over into a machine for turning four throw cranks. The various adjustments of the special fixtures need no explanation. After roughing out on this machine, the cranks are finished by grinding on a regular crank grinder.

Indexing with a Gear

In the cutting of the large bevel-gears, used in their automobiles, considerable trouble was experienced in getting them indexed accurately, so the fixture shown in Fig. 9 was made. This fixture is clamped to the table of an ordinary milling machine, and the indexing disk is simply a specially cut and sized gear which is shown in cut.

A gear blank, bevel side up, is placed on top of this index-gear, the big washer shown leaning against the wall is placed on top and the nut *"C,"* screwed down tight. After one tooth is cut, the clamp is loosened by pressing down lever *B*, and the registering pin depressed by pressing down lever *A*. The index gear is turned one tooth, lever *A* released, and the clamp tightened by means of lever *B*, and another tooth cut.

It is found that much less error is caused by this method of indexing than can be done in any other way.

Engraving Name Plates

Fig. 11 shows the engraving machine used to cut out name plates. The large letters or designs on the master plate guide the rapidly revolving cutter through the pantagraph arrangement of levers, and a small design which is a duplicate in miniature of the master plate is cut on the small strip.

With this machine a name can be engraved on a brass plate almost as quickly as it could be written with a pencil.

A method of polishing small brass nuts and washers as well as other brass parts, is used here that is very seldom seen outside of the jewelry trade, though the unusually good results cause one to wonder why. The method is simply the placing of the brass articles to be polished in a tumbling barrel, together with a quantity of steel bicycle balls.

This tumbling barrel is then immersed in soapy water, made of Ivory soap and water, and tumbled. One can scarcely believe his eyes, if he has never before seen the resulting polish that this gives to brass or even steel.

Fig. 12, shows the way this barrel is placed in the tank. One end of the barrel spindle is square and fits into the pulley socket, and the other end simply drops into a half bearing, making the barrel easily removable.

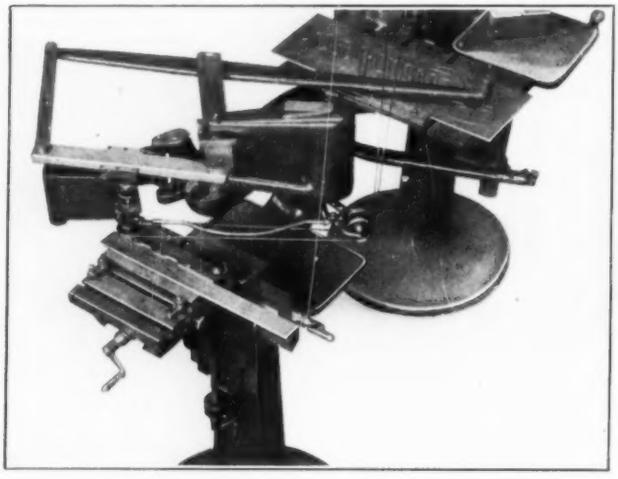


FIG. 11. ENGRAVING THE NAME PLATE

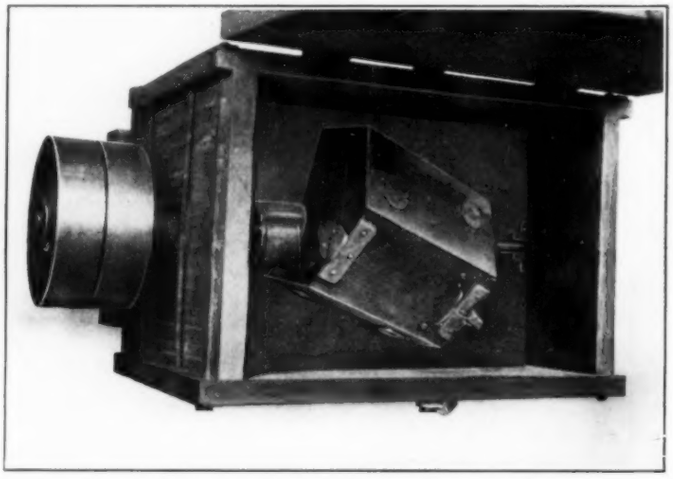


FIG. 12. POLISHING SMALL PARTS BY TUMBLING

Using the Swedish Gages

By C. E. Johansson*

The illustrations show some applications of these combination gages. The first illustration shows a method of using the gages for ascertaining whether the sighting points of a firearm are in line with the center line of the barrel, which is of great importance when manufacturing devices for the adjustment of these points. For the tests the following method is adopted:

At both ends of the gun barrel exactly fitting plugs are inserted, as in Fig. 1, and the barrel is laid upon a surface plate with each plug resting upon a gage, the sizes of which gages, adding half the diameter of the respective plugs, correspond to the distance from the surface of the plate to the center line of the barrel and, consequently, make them exactly parallel with each other. Two profile pieces to fit the shape of the sight slot and that of the sight are combined with gages so as to get the true distance from the points of these pieces to the plate surface, which distance, consequently, equals the distance from the center line of the barrel to the surface plate.

The profile piece made to fit in the sight slot is now pressed into this slot, while the position of the sight is tested by means of the corresponding profile piece and gages combined with it. If now the sight coincides with the corresponding slot in the profile piece, it is at exactly the

*Originator and maker of Swedish combination gages.

same level above the surface plate as is the sight slot; in other words, the sight points are parallel with the surface plate and consequently in line with the center line of the barrel. For further inspection the barrel may be turned half round and the same test made on the opposite side.

If, while performing the above test the profile piece that is to fit the sight should be found lying above or below the sight, all that is required is to increase or decrease the gage until a perfect fit is attained, thus obtaining a correct statement of the error.

The master gage illustrated in Fig. 2 is made up of two plates of different sizes so located relatively to each other that the distances from the upper and the lower edges respectively of the small plate to the corresponding edges of the large plate are the same and equal throughout the length of the small plate.

This is checked in the way shown in the illustration by placing the edge of the gage on a surface plate and pressing the back of it against a square or block in order to insure its right position. A combination gage of a size equal to the distance between the edges of the small and the large plates is made up and inserted between the small plate and the surface plate, and the exactness of this distance throughout the length of the former plate can be checked in this way. For checking the upper side of the master gage the latter is turned and the same procedure followed. Any errors are eliminated by adjusting the holes for the guide pins holding the plates in a given position.

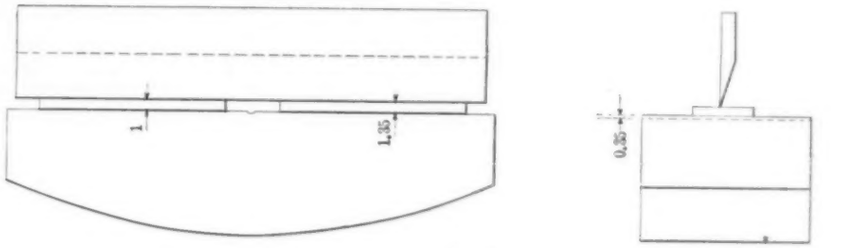


FIG. 3

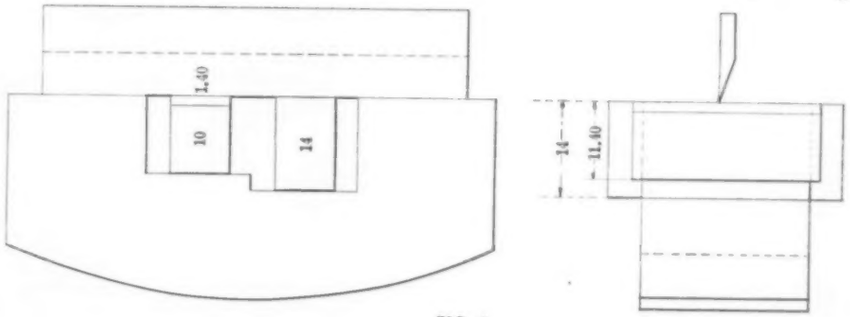


FIG. 4

TESTING THE HIGHT OR DEPTH OF TWO SURFACES

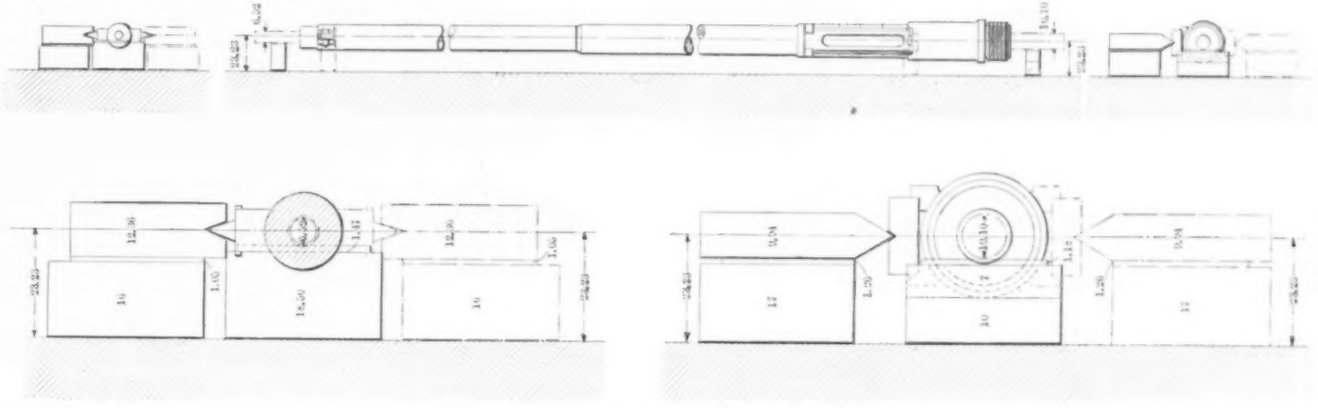


FIG. 1. TESTING THE SIGHTS OF A RIFLE BARREL

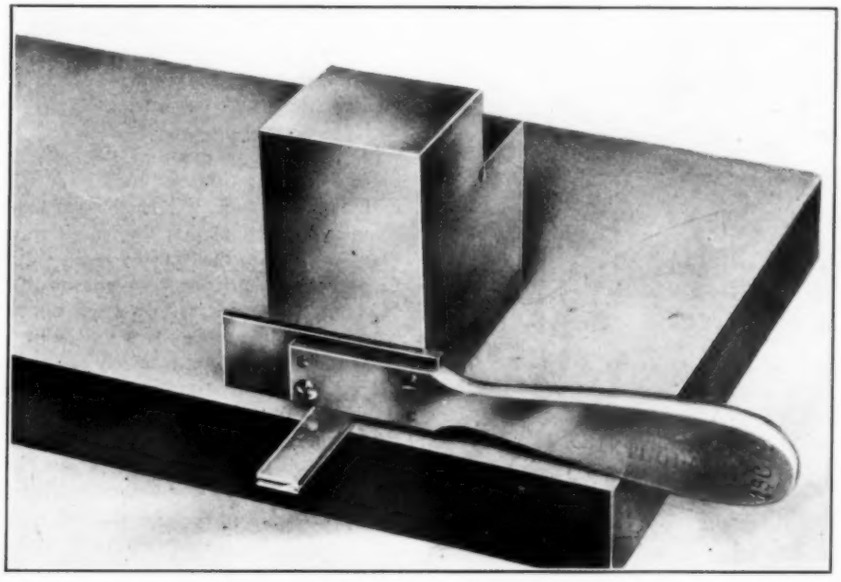


FIG. 2. TESTING A MASTER GAGE

Fig. 3 illustrates the method of measuring a piece having two parallel surfaces on the same side, one of which is on a 0.35 mm. higher level than the other. The side of the work opposite these surfaces having a curved surface offers no point for measurement with a micrometer caliper or the like. To determine the difference in hight of the two parallel surfaces, two gages differing in size by 0.35 mm. (say 1 mm. and 1.35 mm.) are selected and the large one placed on the lower surface and the small one on the higher surface of the piece. The upper surfaces of the gages should now lie in one plane, and this can easily be tested by putting a straight edge over them.

A somewhat similar test on another piece of the same general form as Fig. 3 is illustrated in Fig. 4.

Another Artist Blacksmith

Material, Forge and Tools Used and the Operations Step by Step Necessary to Produce a Spray of Wrought Iron Roses and Leaves

BY E. A. DIXIE

Pride goes before a fall and this time I am it. I was responsible for the writing of the article on "Art Blacksmithing," which appeared on page 721, Vol. 29. I knew the smith, Louis Van Boeckel, and a friend of mine wrote the article at my instigation. Ever since it appeared in the AMERICAN MACHINIST I have done more or less bragging about Van Boeckel and his marvelous work.

Two or three months ago I met a foreman blacksmith, began talking shop, and, of course, brought up Van Boeckel's work. My friend, the smith, didn't say much about what he could do, but intimated that he would like to see a sample of the Belgian's metallic floriculture. That was easy, so I mailed him a sprig of roses which I had, chuckling to myself at the setback he would get in his own estimation when he received it.

The joke is, however, on me. My smith (I found him so I have a right to claim him) has sent me samples of work better than any of Van Boeckel's which I have so far seen. The actual blacksmithing, as apart from the art feature, is better. The welds are cleaner and neater, and the smith has gone closer to nature to get his model. It is perhaps difficult to grasp that blacksmith work could be better than that described in Vol. 29, but this is, according to my opinion.

Another thing in favor of my smith is that he has never attempted anything to which the word art could be prefixed. He is an all-round smith who has handled work in great variety from heavy marine forgings down to razor blades. And further, the work reproduced here was done on an ordinary large forge in which he has welded 6-inch shafting. The hammer and all the tongs used were made by him also, and, by the way, although he did not make the anvil on which the work was done he has also made anvils. He has kept his time on the various operations and has made up a set of component parts so that I can write the job up for the AMERICAN MACHINIST and remove all the mystery.

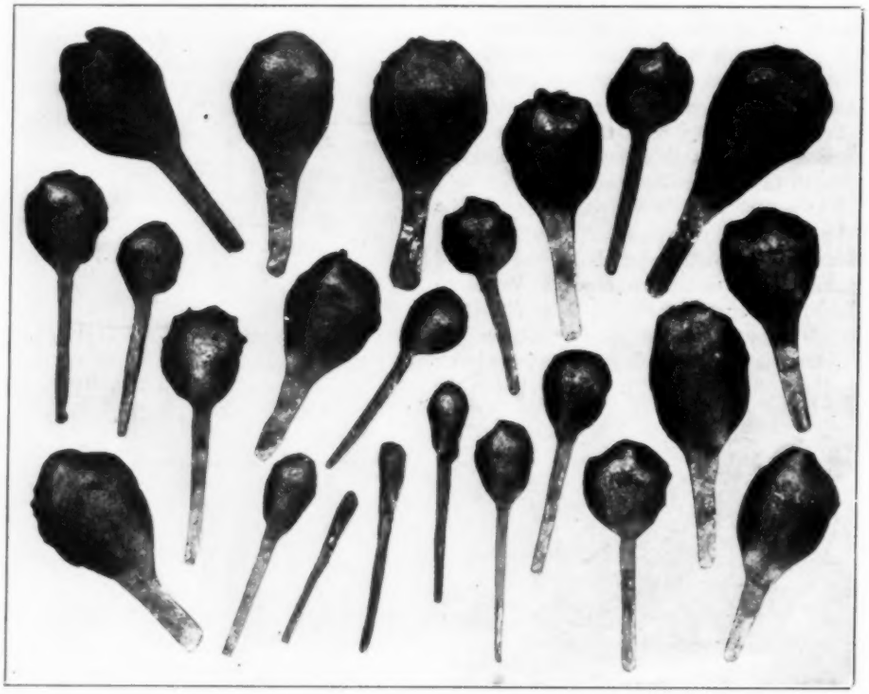


FIG. 2. THE PETALS FOR A SINGLE ROSE

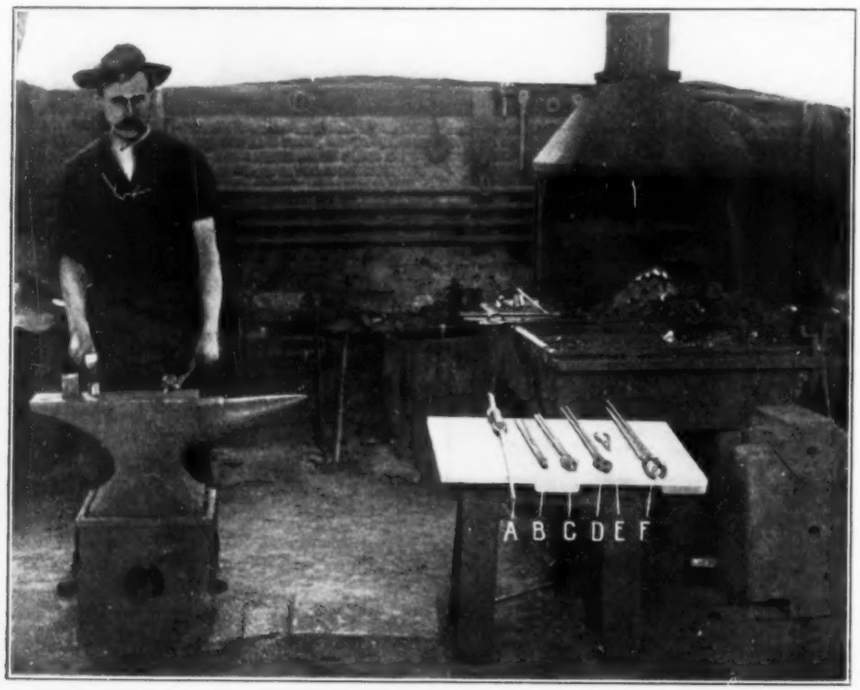


FIG. 1. THE ARTSMITH, FORGE, TOOLS AND MATERIAL

My smith tells me that the spray of roses I lent him did not look quite right to him so he took it into the garden to compare and found that the leaves on the rose bushes in the garden grew either five or seven on a stem and never three, as in the iron sample. As it would not take much more time to do the job right he decided to follow nature as nearly as possible.

Fig. 1 shows the forge and all the tools used, together with the stock from which the various component parts of rose and leaves were forged. I induced him, very much against his will, to stand behind the anvil, telling him I only wanted to use him as a sort of animated yard stick so as to show by comparison the size of the forge and accessories.

The material used was an old chain, the links of which were made of ¾-inch iron. This was heated to a welding heat, hammered together and drawn out under the steam hammer; the only reason for using the steam hammer was to save time, owing to the size of the stock used. The stock in condition for hand forging is shown at *A*, Fig. 1, and alongside it are shown the various tongs used. The stock at the end is drawn to about ⅜ inch square. The component parts, such as leaves, petals and calyxes, are forged separately.

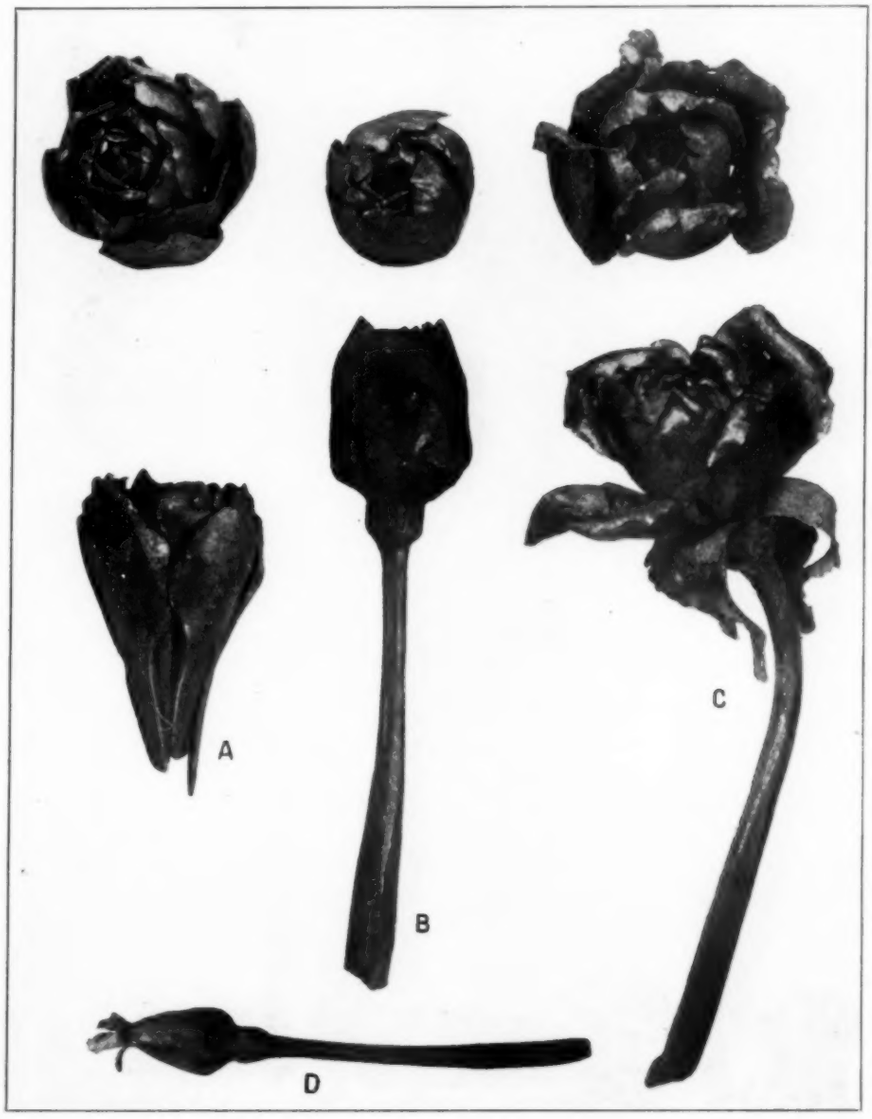


FIG. 3. THE ROSE IN VARIOUS STAGES

Fig. 2 shows the petals of a rose, 23 in number varying in size from about 2¾x¼ to 2¾x1⅛ inches wide. Fig. 3, at *A* shows them assembled ready for holding in the round tongs, shown at *F*, Fig. 1, so that they can be welded. *B*, Fig. 3, shows the rose after the ends of the petals have been welded and the surplus metal drawn out in the shape of a stem. The next operation is to open the petals and shape the rose. This is done by using the small pliers shown at *E*, Fig. 1, the welded rose *B*, Fig. 3, being heated so that the petals can be curled back and crimped by the pliers into the desired shape. *C*, Fig. 3, shows the rose with the petals formed and the calyxes bent back as in the natural rose. Fig. 4 shows the seven leaves just as they are first forged. In the upper right-hand corner at *A* is the piece from which each leaf is formed. This is held in the tongs by the stem, heated and flattened out on the anvil, the center rib in the leaf being formed by allowing that part to lap over the edge of the anvil while the leaf is being flattened. The leaf is then laid rib up and with the cross-pene of the hammer the radial ribs or veins are struck in. A slight tilting of the hammer, the blows being directed to the outside of the leaf, forms the serrated edge.

The leaves are now ready for welding together. Three are taken, gripped by the leaf part in a pair of flat-nosed tongs, while the stems are brought to a welding heat. The three stems are then welded together and drawn out. Two more leaves are added one on either side, another heat, weld and draw out of the stems and then the last two leaves are added in the same manner and the spray of leaves looks like *A* and *B*, Fig. 5, which are respectively flat and edge views. The next operation is to flatten the spray out into the form shown at *C*, Fig. 5, and finally to shape it up with the aid of pliers to the form shown at *D*, Fig. 5. The welding of the two stems together is a small matter in comparison to what has gone before and the building of a complete rose bush is merely a matter of repetition of the same processes.

The small bud shown at *D*, Fig. 3, is made of four petals welded around a central ball. The rose branch at Fig. 6 is the latest production of my smith. It is 13 inches high, is made of 94 separate pieces forged from old chain stock and took 13 hours to make.

To make a finished spray of leaves, as shown at *D*, Fig. 5, takes just one hour. To complete a rose, as shown at *C*, Fig. 3, takes two hours and fifteen minutes, and to weld the leaves to the stem of the rose would take fifteen minutes more or just three hours and a half for the whole job. The man who did this work is James Cran, 916 West Third street, Plainfield, N. J.

An interesting example of the displacing of steam by electricity is pointed out by the *Scientific American* to be in the up-to-date laundry. The electric motor is used to provide an individual drive for the various machines. The principal advantage of electricity over steam in this particular application lies in the fact that many of the machines are idle for a large part of the time, and the driving motor of such machines need only be consuming power when its services are required. In addition to this, greater variations of speed are possible with the electric motor, and the machine may be driven at exactly the speed desired. No overhead shafting or belts are used, thus doing away with the dust and dirt that accumulates in the steam laundry.

Some extensive experiments to show the effect of rolling on the magnetic properties of steel were recently carried out in the German Reichsanstalt, and the results were of decided interest. It was found that the steel was more efficiently magnetic when at right angles to the direction of rolling than when parallel, and the differences were uniformiy quite marked. In connection with sheet steel the investigation also brought out the fact that when annealed it underwent considerable change in a period of six months, magnetically losing considerable of its capacity.

Hardening Carbon and High-speed Steel

By Warren E. Thompson

Specialization places the hardening branch of the machine business in the hands of men who know nothing else in most of the large shops of today. These specialists, as a rule, are not very particular about giving their methods away and the young man learning his trade usually finds himself handicapped when he goes to work in a shop where the toolmakers are required to harden their own tools. The all-round man finds that he must now change shops frequently in order to keep in touch with the different branches of the business and get the necessary experience required of a successful executive. The only way for a young man to become a first-class mechanic after he has served his time is to follow the same course. Eventually he gets into a shop where he is shown considerable about hardening and has a chance to do some thinking for himself. After he has worked in a dozen shops at different branches of the trade and then holds first-class positions in a dozen more he will find that he is in a position to fill about any job at the business satisfactorily.

A few of the hardening methods used by the author are here given. They are not all new by any means, but are reliable, and tools thus treated have stood very favorable tests with the best(?) of hardening. Ordinary carbon-tool steel may

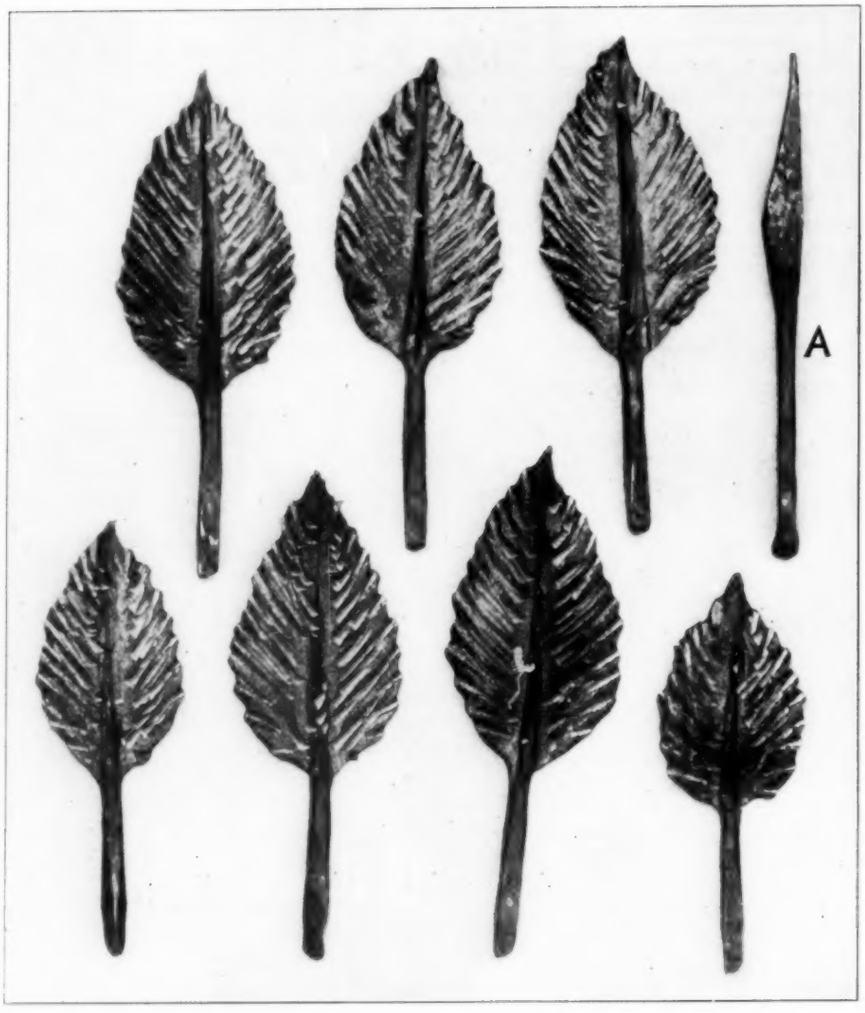


FIG. 4. THE LEAVES READY FOR WELDING

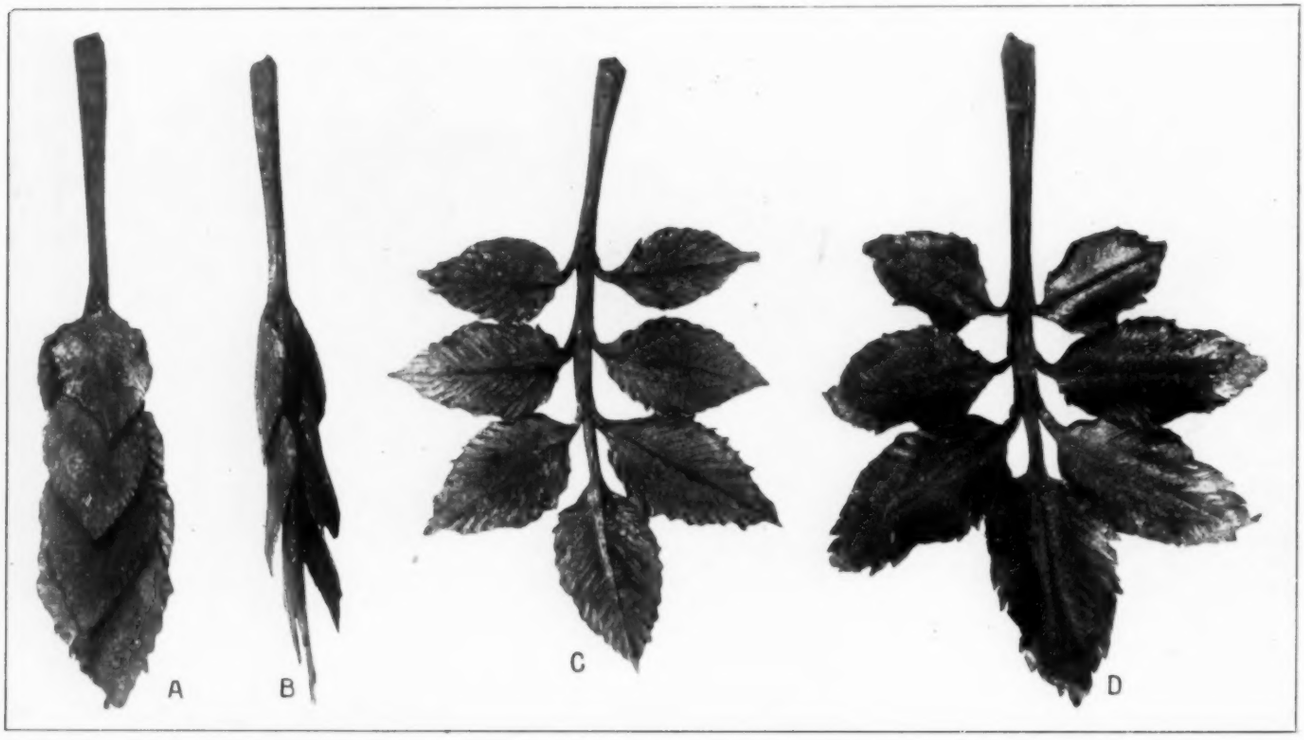


FIG. 5. THE SPRAY OF LEAVES

be heated in about the same manner in all cases.

Lathe tools are heated to an even red for about an inch beyond the cutting edge, then quenched in brine just beyond the edge and polished with an emery stick. The heat from the shank of the tool which was not cooled is then allowed to run back onto the end until the polished cutting edge is a very bright straw color.

Jig parts, gages and similar tools or parts are heated to a low red and quenched in the bath, and then reheated until water sizzles on them. This takes out most of the internal breaking strains and leaves the metal about as hard as it is possible to make it.

Carbon-steel reamers, twist drills, and similar cutting tools are best drawn to a medium straw color, or about 450 degrees Fahrenheit. Carbon-steel dies and cutters are drawn to a medium or dark straw color.

A bath that works very satisfactorily for quenching these steels is made of soft water and common salt strong enough to float a raw potato. A quart of sulphuric acid and a pound of mercuric chloride (corrosive sublimate) added to every 15 gallons of brine increase the hardening properties considerably.

The work may be heated to a very low red and hardened with this bath. When using plain water, tools must be heated to a yellow in order to duplicate the hardness obtained with brine.

When hardening a polished tool it is often desirable to take a little extra care and bring the tool from the quenching bath in the same condition it went into the fire. The polished part can be well cleaned of oil by dipping in the soda kettle, then well wet with clean water and covered with common salt. After heating until red begins to show, sprinkle again with salt and bring to the hardening heat. It is preferable in cases of this kind to use a brine-quenching bath. If the salt sticks to the work after quenching it may be wiped off with waste.

FIG. 6. A SPRAY OF IRON ROSES

Some time ago a number of thin bushings were to be hardened. Ordinary methods were tried, but the work came from the bath too badly warped to be of any use. A pail of dirty brine in which about a quart of kerosene oil had been spilled was near the furnace ready to throw out. During the time the expert was trying to conceive of some way to get over the difficulty a heated bushing was dipped in the pail and tested. Half a dozen more followed the first with practically no change. Thereafter, all bushings were hardened in a mild salt bath with a layer of kerosene oil on top.

To harden thin scales and pieces of like form—float a piece of newspaper longer and three times as wide as the scale on the surface of the quenching bath until it shows wet clear through. Heat the piece to be hardened as evenly as possible and grip it by the middle with thin-pointed tongs. Plunge the hot scale edgewise onto the floating paper and into the bath. This causes no warp in most cases. Reamers of the shape shown in the cut should be plunged into the bath at an angle of from 30 to 70 degrees, depending upon the shape of the reamer, with the round side down. When these reamers are dipped straight they invariably curve, making it necessary to either grind or anneal and work them over again. If the angle at which they are dipped is judged well and any change noted, the reamer may be rehardened and brought back to straight by dipping at a different angle.

Gears, clutches and parts of like nature may be surface-hardened or hardened clear through. Chrome-nickel gears which are hardened clear through or nearly so seem to stand the most severe test of any. The 40- to 60-point carbon-steel gears, surface-hardened, however, stand very hard usage. These gears may be hardened clear through but do not stand the sudden shocks, such as automobiles contract, as well as those surface-hardened.

A lot of chrome-nickel gears were packed in old bone and heated to a low red, held at this heat for three hours and dipped in linseed oil. These gears stood a higher test than gears hardened by any of the other methods at our command.

Gears of 50-point carbon steel were treated by the following method:

Pack the pieces in new bone clear of any cast iron, i.e., do not have the gears within ¾ of an inch of the sides or bottom of a cast-iron box. A small percentage of charred leather mixed with the bone helps the carbonizing but is not necessary. Fill the holes, if any are wanted soft, with old bone. Seal the boxes tightly with the exception of a small hole in the side for testing purposes. Start the furnace and raise the heat to an even cherry red before putting in the boxes. When the center of the box reaches a low red, hold the heat for from one-half to one hour and take it out. Then dip at a low red, or about 1200 degrees Fahrenheit, in thin oil such as cottonseed, linseed, or lard oil. The pieces should come from the bath with a glass-hard exterior and soft core. If they are not satisfactory the first time reheat in the open fire and quench at a different temperature.

It is possible to harden 50-point carbon

steel clear through by heating to from 1300 to 1400 degrees Fahrenheit, but the resulting gears are easily cracked and broken.

When testing the heat of the center of a sealed packed box, a wire is put through a testing hole into the center of box and pulled out frequently until it shows the desired heat.

A gear may be given a deeper outside surface-hardening by letting it "soak" at the

REAMER TO BE HARDENED

red heat for from 2 to 8 hours depending on the depth desired.

A gear hardened by this method was firmly clamped in a heavy vise and the teeth hammered with a two-pound hammer and staking tool. The outside was too hard to file but the teeth first dented, then bent, and finally broke off after being hammered out of shape. Gears of the same steel hardened clear through snapped like glass with a few medium blows.

Machinery or low-carbon steel heated in melted cyanide of potassium, at a cherry red heat and quenched in clean water, takes a fair case-hardening and a handsome finish. The cyanide should be used in a special furnace with a graphite crucible. Cyanide, however, penetrates but a slight amount and should not be used on jig and fixture or like parts. Bone is the best medium—commercially speaking—to use on machinery steel. The methods of treating high-speed steels vary with the brands of steel and different shops. The composition of these steels necessitates a special treatment as the ordinary methods will ruin it in nearly every case. Blue chip, Novo, and Rex high speed treated by the following methods stand very severe usage.

Small tools well cleaned of oil then dipped into clean water and then into a mixture of salt and cornmeal, or salt and powdered chloride of barium in equal parts, may be heated to a low red heat, dipped into the mixture again until thoroughly covered, then heated to a yellow heat and quenched in oil and salt. This brings them out clean with no scale. If the burnt mixture does not drop off in the bath it may be wiped with a rag.

Cutters, large drills, screw-machine forming tools, etc., give excellent service when heated in the following paste: Water 2 quarts; common salt, 1 pound; cyanide of potassium (25 per cent. solution with water) ½ pint; cornmeal, 3 pounds; and liquid glue ½ pint. The cyanide is best dissolved in boiling water and used in liquid form. Mix the ingredients thoroughly to form a paste about as thick as putty.

Pack the cutter in an iron box together with this paste and seal the box except for a test hole in the side. Bring the center of the box to an even low red and hold at this heat for half an hour, then take the work out and quench it, at a cherry red, in raw linseed, cottonseed, or other thin oil to which a pint of common salt has been added to every gallon. The quenching heat must be watched very carefully as a high heat will develop cracks in the majority of cases.

The paste as a rule will drop from the work into the quenching bath. When some of it sticks to the piece it will have to be removed by artificial means. The sand blast is the very best method as it makes a fine finish. In shops where no sand blast is available a wire brush used in a speed lathe will clean all parts of the work.

Tools hardened by this method usually come out of the bath from a clear white to dark gray color, the sharp edges and corners are preserved, and the steel is rendered very durable. Novo steel is susceptible to slight changes in temperature and different quenches. For instance, if the tools are heated to a cherry red and dipped in boiling water they come out hard. If they are heated to a very low red and dipped in clean cool water they will become as soft as well annealed tool steel.

Milling Fixtures Used in a Russian Shop

By J. W. Carrel

At the shop of J. A. Semenoff, St. Petersburg, there are many ingenious devices and methods used in connection with the manufacture of cigarette machines. The accompanying illustrations represent special fixtures employed for mill-

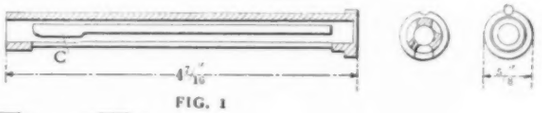


FIG. 1

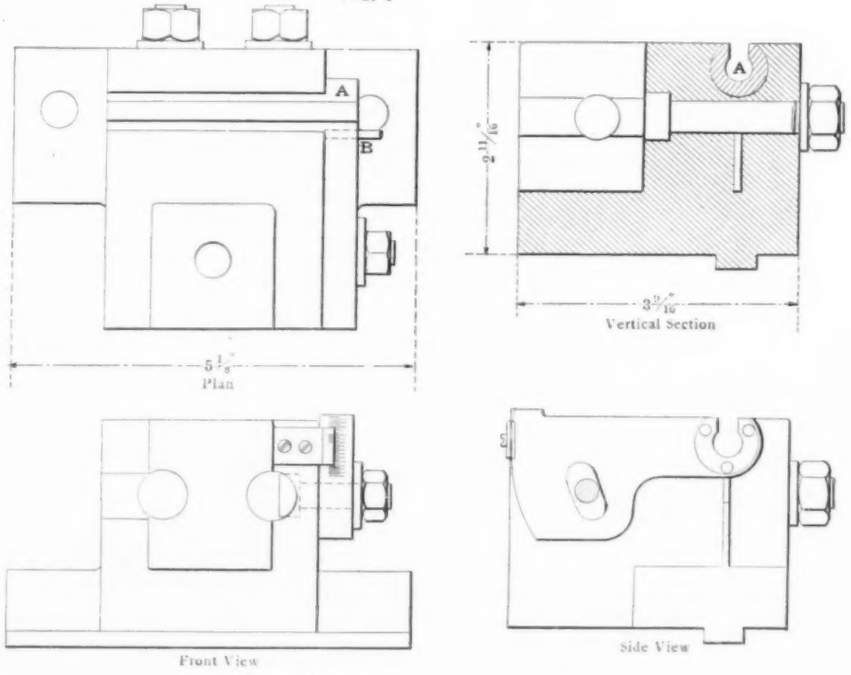


FIG. 2. SLOT MILLING FIXTURE

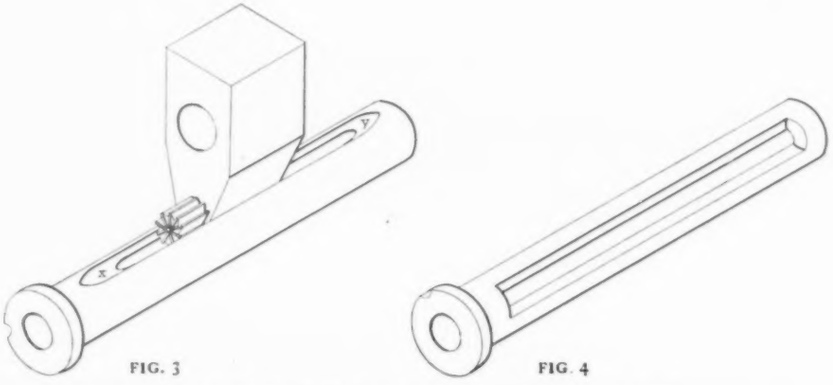


FIG. 3 FIG. 4

APPEARANCE OF SLOT BEFORE AND AFTER FINISHING THE ENDS

ing slots in the tubes used in such machines.

One of these tubes is shown in Fig. 1. The straight slots are cut with an ordinary milling cutter, while the work is held in a fixture of the type shown in Fig. 2. The tube is located in the holder *A* by a pin in the face of arm *B*, which enters a semi-circular notch in the head at the end of the tube. Part *A* may be turned in its seat in the fixture to allow the offset portion of the slot at *C*, Fig. 1, to be cut, and the adjustment for this purpose is accurately made by means of the graduations on the rear end of arm *B* and the vernier plate attached to the fixture base. When set, the carrier *A* is secured by the clamping nut at the side of ring *B* and the nuts at the front, which bind the work and its holder securely in place.

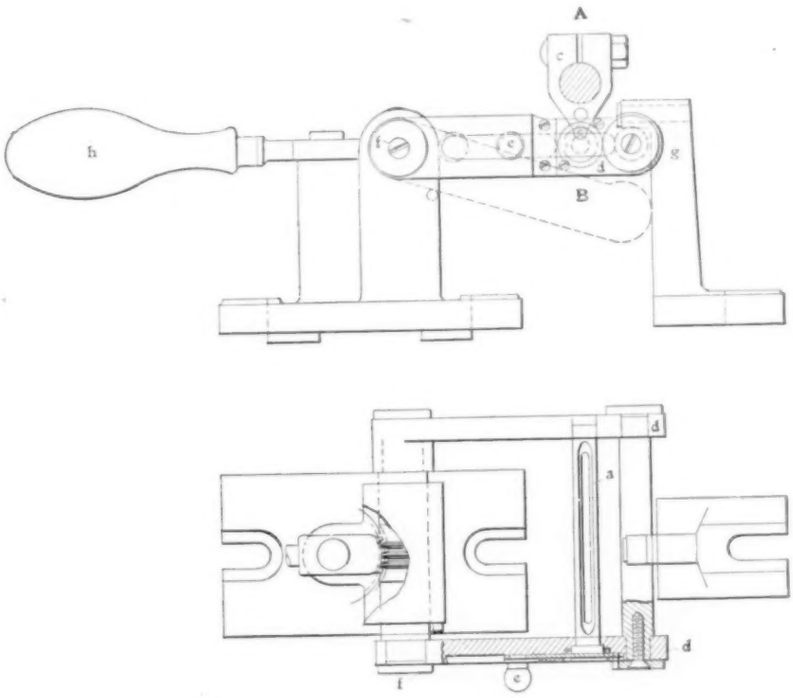
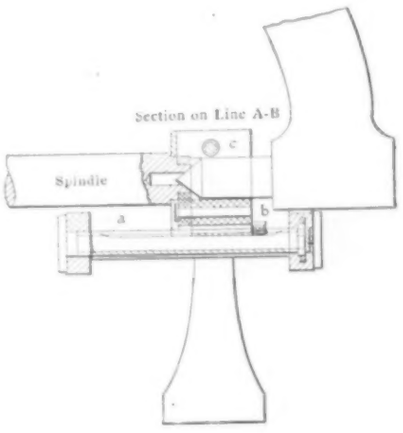


FIG. 5. FIXTURE FOR FINISHING ENDS OF SLOTS



In forming the straight slot with the milling cutter the ends of the slot are left as at *x y*, Fig. 3, and have to be squared up in another operation. This is accomplished with a special end-milling attachment, operating in the slot as indicated in Fig. 3 and squaring up the ends of the slot, as shown in Fig. 4. The method of holding the work and performing this operation is illustrated in Figs. 6 and 7.

This attachment has been designed to mill out the ends of the slot in tube *a* by means of a small end cutter. The cutter *b* is placed parallel to the main spindle.

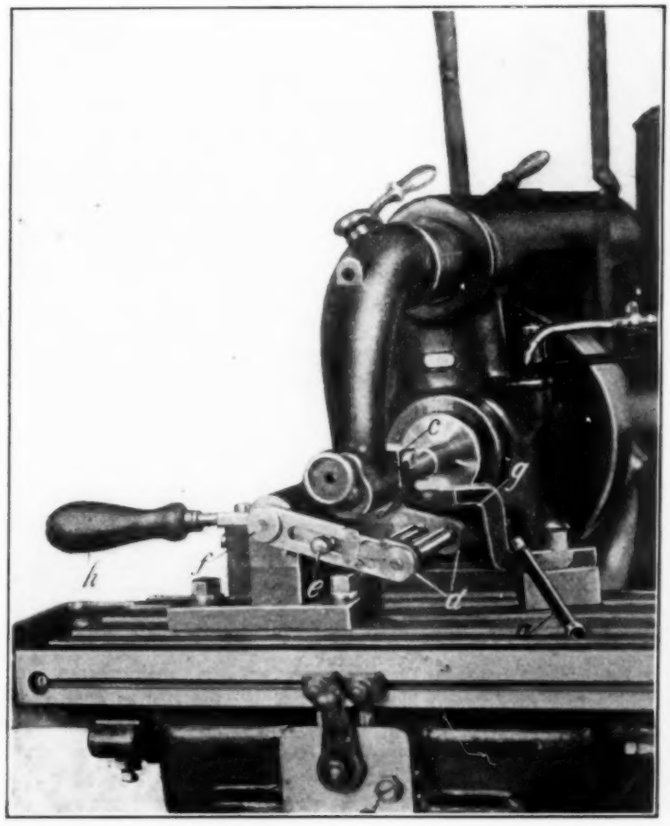


FIG. 6

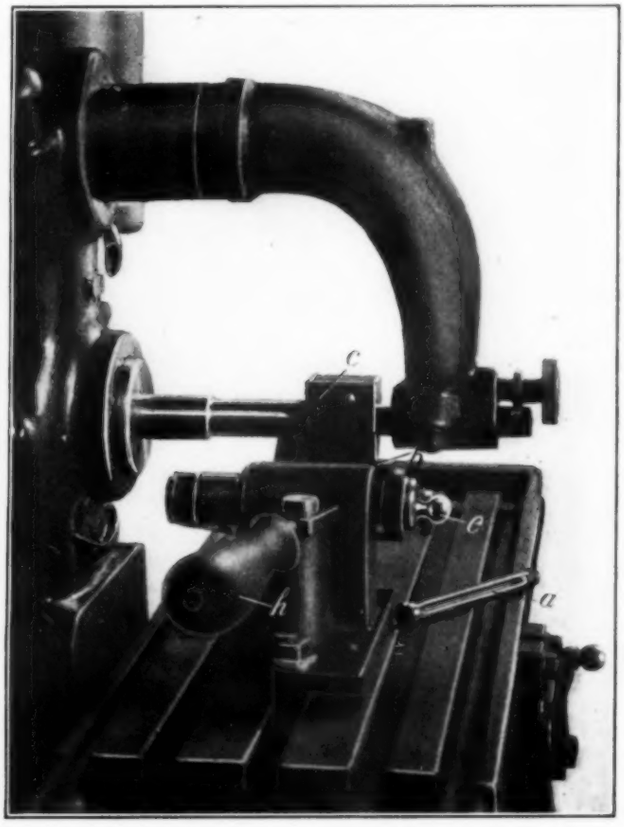


FIG. 7

FIXTURE FOR MILLING ENDS OF SLOTS

Its bearing *c* is fixed at the center of the overhanging arm. The cutter is driven from the main spindle by means of gears. Piece *a* is fixed in the pair of arms forming the frame *d*, by means of the locking device *e* and a pin, which fits in the locking slot. In operation the frame is swung to the proper hight by hand round the stud until it strikes against the stop *g*. The whole attachment is so arranged as to bring the cutter *b* into the slot in the tube as soon as the frame *d* strike against the stop. Then the tube is moved endwise by the lever *h* until the work is finished as required.

The construction of the holding fixture is more clearly shown in Fig. 7, where the same reference letters are used as in the half-tones. The lever *h*, as will be seen, is provided at the inner end with teeth engaging with a cylindrical rack formed on the circumference of stud *f*. The lever thus provides a means of swinging the work up to the cutter and then feeding it endwise against the cutter teeth.

Forming Dies for Railroad Forge Shops

By G. M. Steward*

Fig. 1 furnished by Mr. Mayer, of the Michigan Central Railroad at Detroit shows in detail a die for the making of 5/8-inch round hand holds or grab irons on the 1½-inch Ajax upsetting and forging machine. The pear shape of the upset, under action of the punch, can be seen in the dies at *A*, *B* and *C*.

These dies are made of cast iron and are put in service just as they come from the foundry, without machining, and are good for from 10,000 to 12,000 grab irons.

Fig. 2, also furnished by Mr. Mayer, is a bolt-heading die which can be applied to any style of bolt or forging machine from 5 inches to ½ inch. When this die was first installed, steel was used in its construction and 5 to 6000 bolts could be made on one pair. After changing the style of this die, making the side blocks adjustable and using cast iron, 81,000 7/8-inch bolts were made with one pair and 100,000 ¾-inch bolts with another, all of these dies being good for more, as none of them had been in the machine shop for repairs. Mr. Mayer also has in service various other styles of dies

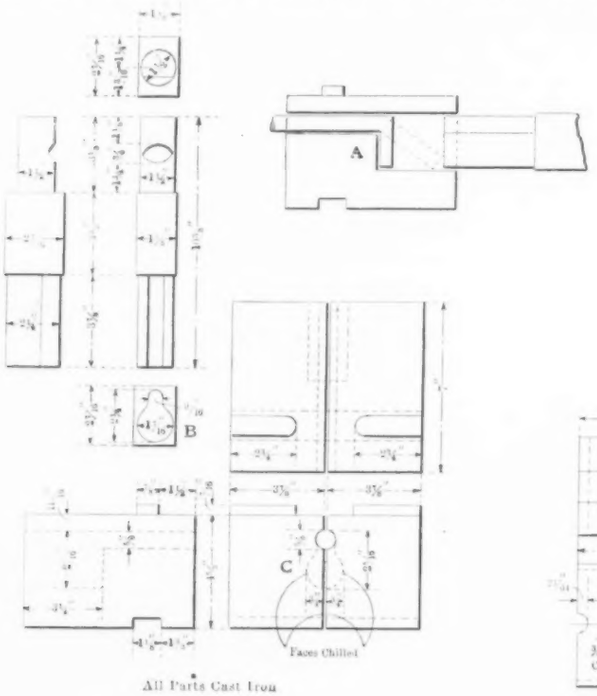


FIG. 1
UPSETTING DIES

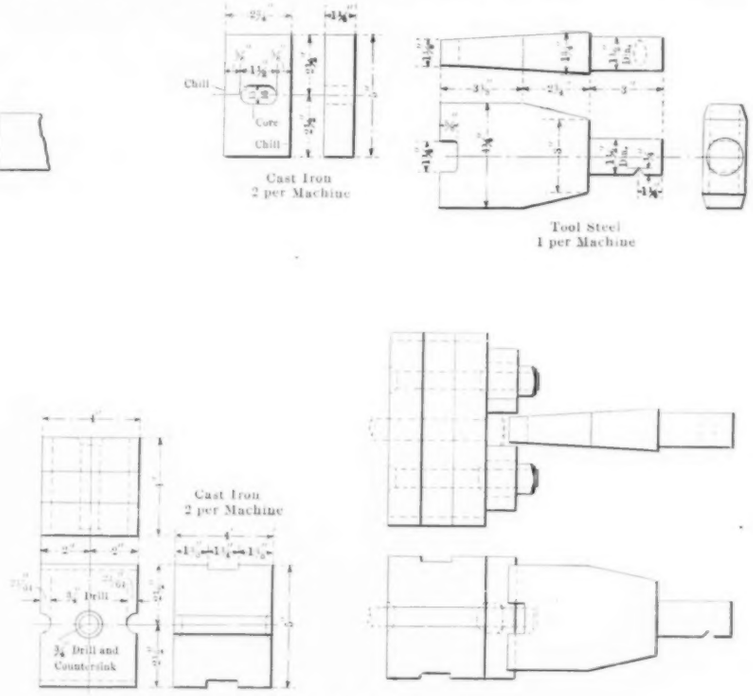


FIG. 2
BOLT HEADING DIES

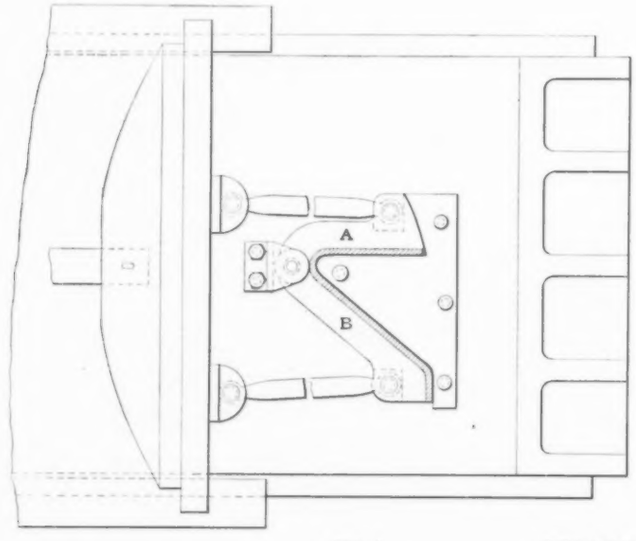


FIG. 3

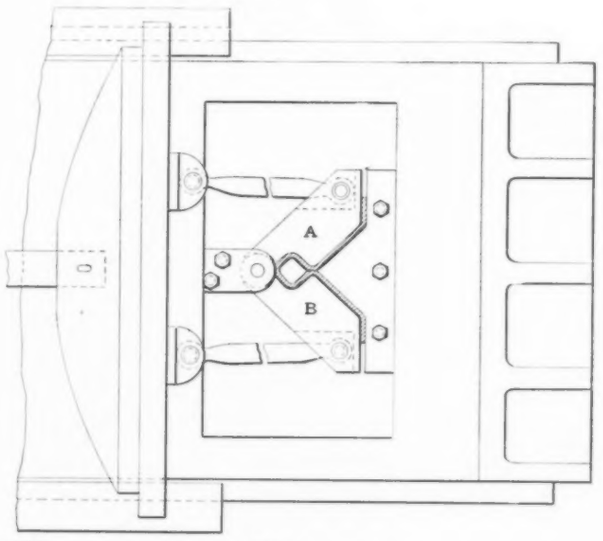


FIG. 4

TWO BENDING DIES

*Foreman Pennsylvania railroad car shop smith shop. Extracts of a report before International Railway Master Blacksmiths' Association.

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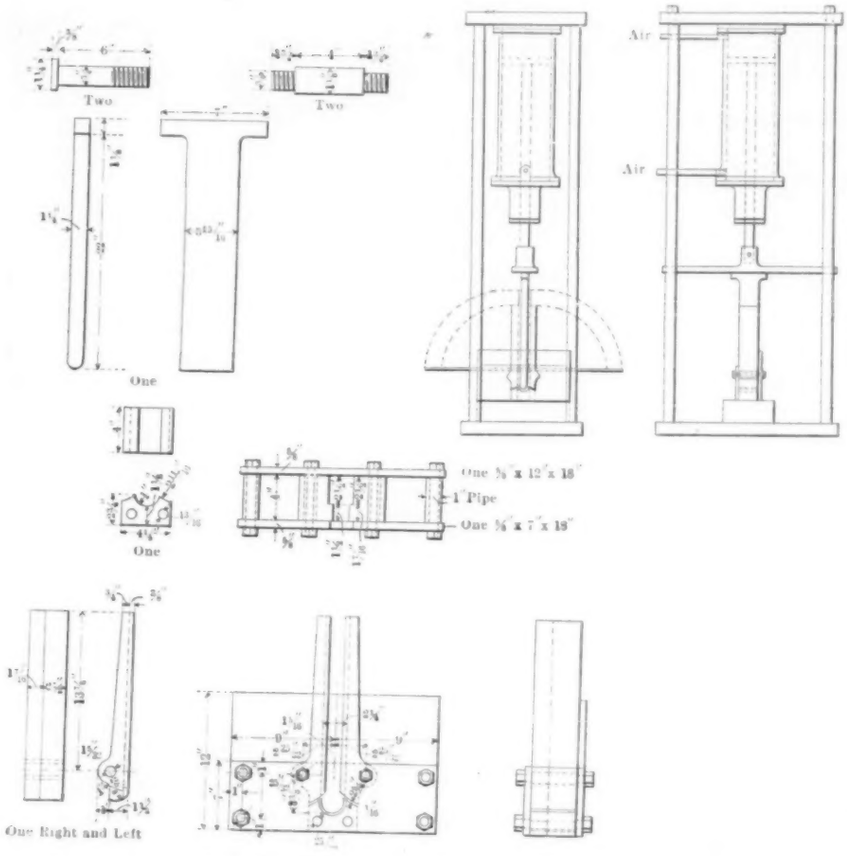


FIG. 5. A CHEAP FORMING PRESS

such as for the making of brake pins, upsetting and nut-punching dies, all made of cast iron.

Several interesting devices are in use at the Pennsylvania Railroad car smith shop at Altoona, Penn. Fig. 3 shows in detail a former for bending running-board brackets for box and refrigerator cars. These brackets are made from ½x1½-inch material, cut 22½ inches long. With wings *A* and *B* of former standing open, a piece of material is placed in position and each motion of the machine forms a complete bracket.

Fig. 4 shows in detail a former for bending brake-shaft brackets for box cars; these brackets are made from ⅜x1½-inch material, cut 14¼ inches; a piece of this material is placed in position, wings of former *A* and *B* standing open, the process being the same as described in connection with Fig. 3.

A Cheap Bending Machine

It is the practice at Altoona car shops to use these formers on a temporarily constructed air machine which is described in detail in Fig. 5. It will be readily seen from this print that this makes a very cheap bending machine, which almost anyone can use, providing a supply of compressed air is at hand.

Fig. 6 shows a die designed for the forming of tank supports for the new steel dining cars. These supports are made from sheet steel 3/16x14¾x57 inches. This die can be adjusted to either bulldozer, hydraulic press or steam hammer.

Fig. 7 is a die for bending brake-beam safety hangers for 4-wheel passenger-car trucks, this one being similar to the one described in Fig. 6 and operated in the same manner.

Fig. 8 shows a wing die for bending Westinghouse friction draft gear yokes. These yokes are made from 1¼x5-inch material, cut 78 inches. Both ends are first upset in a forging machine, after which yokes are heated in center, placed in this die and one revolution of the machine forms a yoke and punches the center hole.

Fig. 9 is a wing die for completing brake-hanger bearings for freight-car trucks. These are made from 1⅛x3¾-inch material, cut 42½ inches long, being first bent to shape excepting the turning of the eyes. They are then taken to a punching machine where all holes are punched, then reheated and placed in this die, which straightens them and turns the eyes complete in one operation.

Space will not permit even mentioning all of our dies, as they now number more than 2000, so I have shown only a few of a character which would be most beneficial to smaller shops, as that seems to be the most important question of the day in this connection.

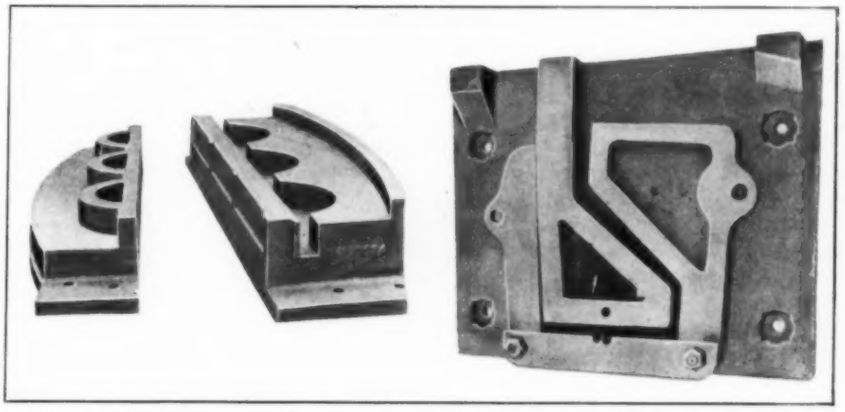


FIG. 6. DIE FOR TANK GRAB IRONS

FIG. 7. BRAKE BEAM DIES

FIG. 8. WING DIES FOR FRICTION DRAFT GEAR

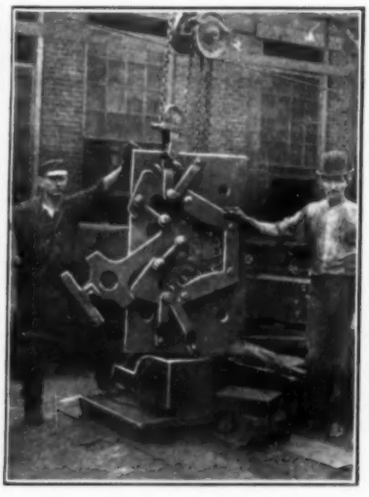


FIG. 9. DIE FOR BRAKE HANGER BEARING

Barium Chloride for Hardening Steel

Design of Furnace, Heating and Composition of the Barium Mixture, Cost of Operation, Method of Suspending Work and Results Obtained

BY ETHAN VIALL

Many extensive users of high-speed steel have adopted the barium-chloride bath as the most satisfactory method of heating high-speed tools, especially those of irregular shape, or with sharp edges and for the benefit of those who would know more of the process, I have obtained some valuable information from D. G. Clark, of the Chicago branch of the Firth-Sterling Steel Company, who perfected this process for them and was one of the first in this country to use barium chloride for hardening steel.

The hardening room of this company was described by O. M. Becker, on page 519, Part 1, Volume 31, of the AMERICAN MACHINIST. It is used for doing a general hardening business for the users of their blue-chip steel. As a consequence of this the work they get to harden varies from small taps to huge, complicated dies, and Mr. Clark, who has direct charge of the hardening plant, is probably better posted than anyone on this method.

ADVANTAGES AND COST OF BARIUM CHLORIDE

The great advantages of using the barium-chloride bath are its convenience; the slight danger of warping the steel; the lack of injury to sharp corners from overheating; the freedom of the treated steel from the effects of oxidation; and finally, its comparative cheapness.

Commercial barium chloride, in 1000-pound casks, costs about 3 cents per pound, and with a furnace having a No. 60 crucible, about 100 pounds per month will be used. A new crucible, costing $3.60, will be needed about every two weeks if the work is such as to keep the bath heated the full day, otherwise the crucibles will last longer. In addition to the barium chloride, about 2 per cent. of soda ash (carbonate of soda), costing 2 cents a pound, is added to prevent fuming.

A good crucible is absolutely necessary,

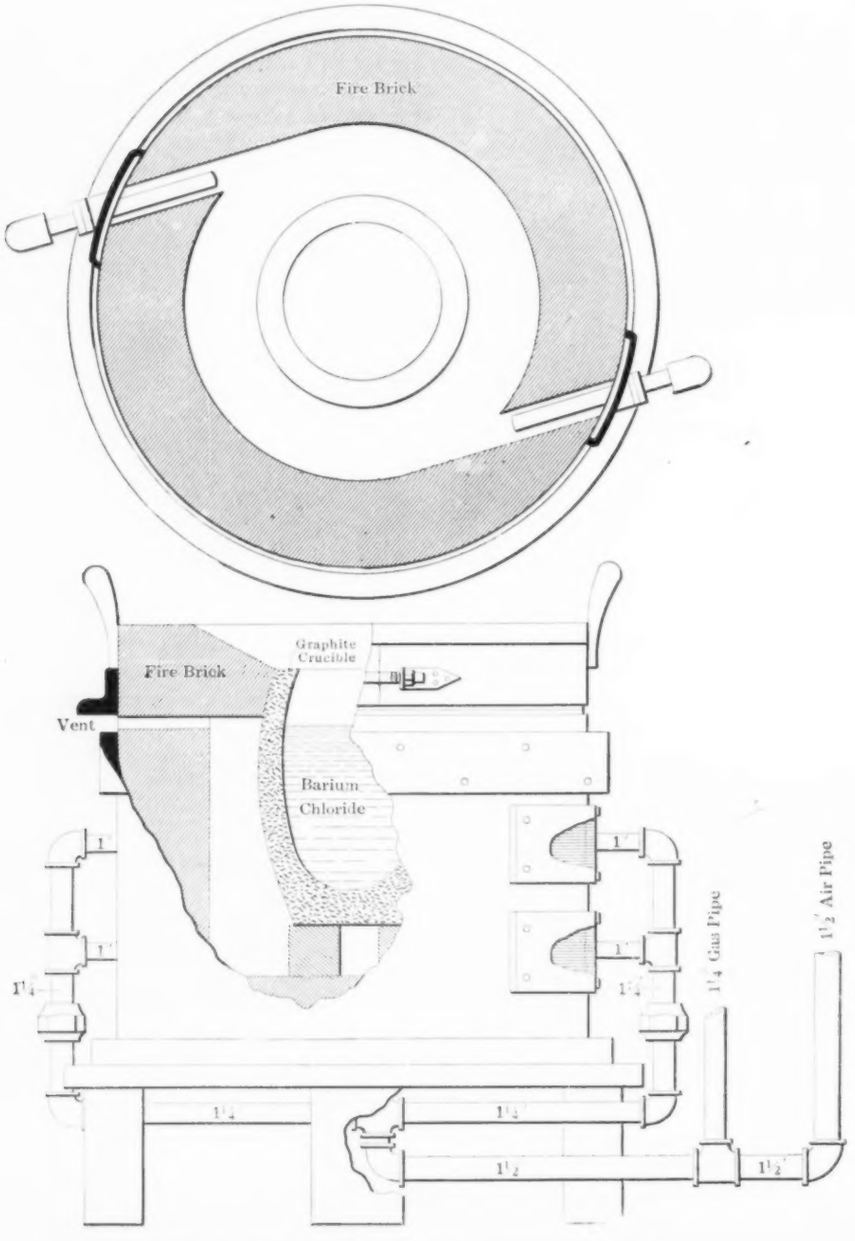


FIG. 1. DETAILS OF THE BARIUM CHLORIDE FURNACE

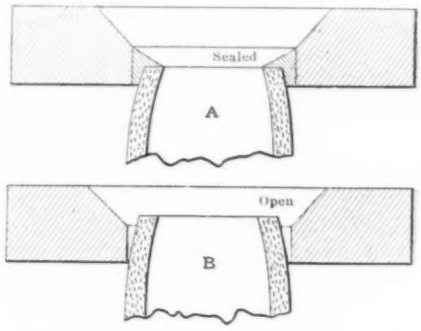


FIG. 2. SEPARATING THE GASES FROM THE BARIUM

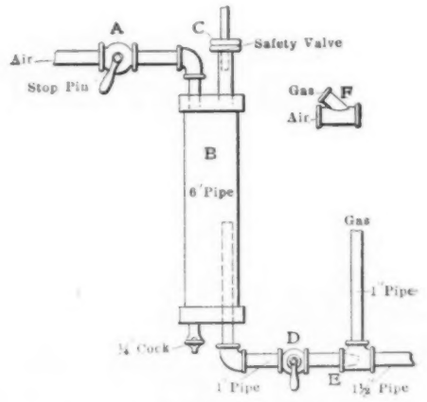


FIG. 3. AIR PRESSURE REDUCER

the No. 60 graphite crucible being very satisfactory for all-round use. In it tools 6½ inches in diameter and 5 inches thick, or slender tools 12 inches long may be heated. These crucibles may be used until they break through, which is usually near the surface of the bath and the small amount of barium that then runs out does no harm.

Any furnace in which a crucible can be held at a heat of 2100 degrees Fahrenheit, which is the highest heat at which barium chloride can be used without pitting the steel, may be successfully used, and it may be fired with oil, coal, coke or gas, but as

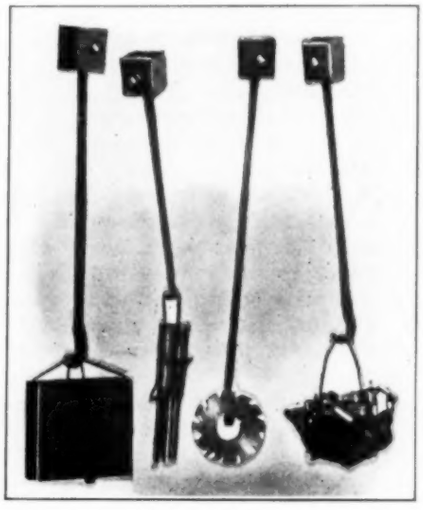


FIG. 4. METHOD OF SUSPENDING WORK IN BARIUM CHLORIDE

gas is used entirely at this plant, all remarks concerning furnaces must be taken as applying especially to gas furnaces.

Construction of Furnace

The style of furnace used is shown in section in Fig. 1. The angle of the gas burners in this furnace gives a rotary motion to the flame, which insures uniform heating of the sides and bottom of the crucible.

The walls of the furnace are firebrick about 4 inches thick, and the space between the walls of the furnace and the

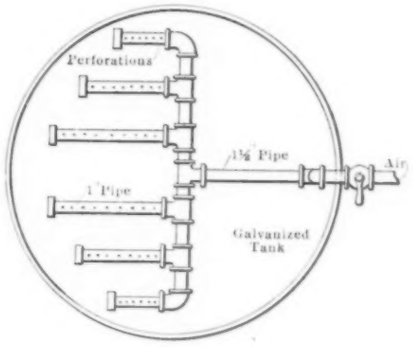


FIG. 5. COOLING THE QUENCHING BATH

crucible is about 2 inches, at the bulge in the crucible.

There are two ways of placing a crucible in the furnace to prevent the gases from coming in contact with the bath. These are shown in Fig. 2. In *A*, the space between the top of the crucible and the top of the furnace is sealed with fireclay, and in *B* the crucible is set high enough, so that the top projects above the combustion chamber. This last method is considered preferable.

An air pressure of at least 1 pound to the square inch is necessary. The ordinary fan blast is not sufficient for this, and where compressed air is used, a pressure reducer similar to that shown in Fig. 3 is suggested. In this cut *A* is a valve with an adjustable stop, or gage on it; *B* is a 6-inch drum with a pet cock for draining off the water that appears when the air expands; *C* is a safety valve set for 1½ pounds; *D* is a valve for regulating the supply of air to the furnace, and *E* and *F* are special forms of fittings to prevent the air from backing up into the gas pipe.

In using this reducer, the valve *A* should be opened to the stop, which is set so as to admit just enough air to cause the safety valve to flow off gently when valve *D* is wide open. The valve *A* should be open only when the furnace is used, but the flame should be controlled by valve *D*.

The Barium-chloride Bath

In starting up for the first time the crucible should be filled with the barium-chloride mixture, while cold, and heated slowly, then more mixture (98 per cent. barium chloride and 2 per cent. soda ash) added as this melts, until the crucible is nearly full. After the mixture is melted, tests should be made with a pyrometer until it is found hot enough for hardening. When through for the day the bath should be allowed to cool with the furnace and when started again it should be heated up slowly.

Owing to the variations in pyrometers no exact degree of heat can be given, but for blue-chip steel the following method is recommended:

After the bath is thoroughly liquid, take a piece of steel with a ground or machined surface; heat it to the temperature of the barium and then dip it in the cooling bath; brush off, and if there are no "bubbles" or "blisters" on the piece, heat the bath to a higher temperature and repeat the treatment. Continue this until bubbles appear, and then note the temperature shown by the pyrometer. Mr. Clark advises the regular use of a temperature 50 degrees below the point at which bubbles appear, the test being made with a new clean bath. The work should be suspended through a small hole that is in the center of the furnace cover, by means of special hooks such as are shown in Fig. 4.

FIG. 7. DRILLS, REAMERS AND MILLING CUTTERS HARDENED IN BARIUM CHLORIDE

FIG. 6. TOOLS HEATED IN BARIUM CHLORIDE AND QUENCHED IN OIL

As the bath becomes old or dirty, and sluggish from steel scale, etc., bubbles will sometimes appear at a lower temperature than they should, in which case the remedy is a fresh bath in the crucible. This bubbling, blistering or pitting seems to have caused trouble to a number of users of barium chloride and if they will follow the hints here given they will have no more trouble.

Quenching and Drawing

The cooling tank should be ample in size and filled with some clean oil, such as fish, cottonseed or linseed, and this should be cooled in some way. The system of air pipes, shown in Fig. 5, is used here, and their arrangement and position at the bottom of the tank keeps the oil cool and circulating properly.

In order to prevent cooling the barium chloride too much, large tools should be preheated to a red heat before immersing. This may be done in any suitable way, but an oven furnace or a lead bath are recommended.

In case barium chloride should remain in the sharp angles of a tool after cooling, it is easily removed by putting the tools in boiling water for a few minutes. Where tools need to be drawn, hot oil is the best.

In order to show the clean, bright surfaces of tools properly hardened by heating in the barium-chloride bath and quenching in oil, a number of tools are shown in Fig. 6. These are woodworking tools and the sharp points and edges are absolutely perfect and free from flaws or bubbles. In Fig. 7 are shown milling cutters, drills and reamers, all photographed just as they came from the oil-cooling bath, after being heated as described above.

True Test of Tools

In testing tools, judgment should be withheld until the tool has been tried on the machine. The file test no longer decides what may be expected from a tool or die. A good file will "touch" a hard blue-chip tool. A tool may be too hard for the best work and yet be "touched" by a good file.

The file test for hardness or softness is doubtful and misleading, unless considered in connection with the actual performance of tools at work. A tool may be hard in one shop, by the file test, and soft in another. The difference is in the files. The real test of a tool is the work it will do and time spent in experimenting to fit the temper to the work is time well spent.

If the temper of a tool at work has been found right by results, this establishes a *known standard* for comparison with new tools and a good file is then useful, to the man of experience, as a guide for the temper of new tools for the same class of cutting.

Salient Points for Inventors—Diligence

By John D. Morgan

Diligence is not primarily necessary. The law, in stating what a person must be or do to get a patent, says nothing about his being diligent. So, the courts in construing the law have said that as between himself and the Government an inventor does not need to be diligent. The invention is the secret of the inventor. The Government says that if he will give it up, he will be protected for seventeen years in the exploitation of it. In giving it up, the inventor is required to publish a "full, clear, concise and exact description" of it "sufficient to enable those skilled in the art to which it belongs" to "make, use and practice the invention." As soon as the period of governmental protection for him is over, his patent ought to be sufficient to enable others to make and use the invention.

Time	Jones	Smith	Brown
1895			A
1896		A	
		C	
1897	A		
	B		
		E	
1898			C
			D
1899		D	
	D		

TABLE I: RELATIVE DILIGENCE OF THREE INVENTORS WORKING ON THE SAME INVENTION

It should be clearly understood, therefore, that the somewhat extraordinary privileges granted to a patentee are largely in the nature of a preliminary inducement for him to publish something valuable to the industrial arts which is his own absolute secret. He is entirely free and independent to accept the Government's offer or not, and it is merely in accordance with this general freedom of attitude that he should be allowed to take advantage of this offer whenever he chooses to. This is the situation, in theory at least, between the inventor and the Government.

Rival Inventors

It is, however, no uncommon thing for two or more inventors to make the same invention about the same time. Cases have been known where even scores of inventors have invented practically the same thing within a sufficiently narrow space of time that all their applications are before the Patent Office together. This is not such an astonishing thing when we come to think of it. A great many studious, brainy men are engaged upon nearly every art. They have had more or less instruction in mechanics and experience with machinery. If we then think of a number of them recognizing a certain need in the industrial world, and entering upon the task of inventing means to meet that need, it must follow that everyone who progresses along true, scientific and mechanical principles, and this includes every successful inventor, must come out pretty nearly at the same place.

When we consider that the particular art as viewed by the particular men at a particular time is in practically the same condition, they naturally see the same need. Starting at the same place, and at about the same time and going in the same direction, it is not much wonder that they arrived at the same place. In one sense that place is the successful mechanical embodiment of a better machine or apparatus than the old ones in use. In another sense the place they arrive at is the Patent Office.

Inventions Gradual, Not Instantaneous

Now, as the law directs the patent to issue to the first inventor, a patent to anyone else would be worthless. If several applicants ask for patent on the same thing at the same time, it is clearly the duty of the Patent Office to find out which of all these is really the first inventor. Accordingly, whether they be two or twenty, the Patent Office has a trial wherein each applicant has an opportunity to show if he can that he is that first inventor. This trial is called an "interference" proceeding. If an invention were made in a minute it would be a simple matter for the Patent Office to arrive at a decision.

As has been previously explained in the article on "Reduction to Practice," the making of an invention is a gradual thing. There is first recognition of the need, then the mental conception of means for meeting it, probably then general sketches and descriptions of the essential or broad idea of such means, and then the more or less gradual working out of a successful commercial embodiment through successive drawings and descriptions or perhaps through successive machines or devices, or of a combination of these.

This series of steps we may for convenience designate:

(a) Conception.

(b) Making of sketches or describing to others.

(c) Making of model.

(d) Filing application for patent in Patent Office.

(e) Building actual machine.

The two tables, utilizing the above symbols, illustrate two actual cases which were before the Patent Office, the details of which will be at once clear.

Although Brown, as will be seen from the table was the first to conceive the invention and first to file his application in the Patent Office, yet Smith was decreed the prior inventor. Brown was defeated because the Patent Office said he lacked diligence from the early part of 1896, when Smith entered the field to the latter part of 1898 when Brown filed his application. Brown had a story to tell of how he was delayed in various ways, but it did not appeal to the authorities. One of the strongest points in Smith's favor was the reduction to practice in 1897. It will be noted that this was more than a year before Smith filed his application, which was not filed until after Brown's. This reduction to practice was a small machine made of crude materials, and was merely temporary in the eyes of Smith himself. But it did what the large machine did and was regarded as an actual reduction to practice. This one feature illustrates very aptly certain points brought out in the previous article on "Reduction to Practice."

Table No. 2 presents a very different state of affairs. Its first interest is that it represents very satisfactorily three classes of inventors, the extraordinarily diligent, the ordinarily diligent and the non-diligent. The machine in question was a large and complicated one and the speed made by Gray in developing the invention, filing his application and producing a working machine was rather extraordinary for an invention of such magnitude. Gray spent about $15,000 in developing this invention. White took about half as long again, but considering the magnitude of the undertaking, he made very good progress. Black makes a very poor showing indeed, as it took him six years to prepare his case for the Patent Office, and he never built a machine.

As regards securing a patent, White was defeated before he started in, as Gray had done everything that the law could require of him before White conceived the invention. Black lacked diligence to such an extent that he could not have prevailed against either party, although he was the first by a long time to conceive the invention.

The Basic Principle

The underlying principle on which the cases are decided takes account of the fact that the man who started first may not finish, but it would not be right for that reason merely to deny him a patent, nor on the other hand simply because another man started later without any knowledge of the first man, but finished long before the first man, would it be just to the second man to deny him a patent because he did not start first. The final rule adopted is approximately this: The first to think of the invention, although the last to reduce it to practice either by building a commercial machine or applying for a patent, will overcome the one who thought of it later, but reduced it to practice first, *if the first man did his best.* But he is held to strict account by the Patent Office and must make a strong showing in good faith that he was actually diligent at all times from just before the time when the other man conceived the invention. As a single inventor is not required to be diligent, this obligation to do his best and fastest work attaches, as just stated, just prior to when the second man thought of the invention and must continue by the first man until he has reduced to practice in one of the ways mentioned.

Time	Gray	White	Black
1897			A B
1898	A		
	B		
1899	D		
1900	E		
		A B	
1901			
1902		D	
1903			D
		E	

TABLE 2. RELATIVE DILIGENCE OF THREE INVENTORS WORKING ON THE SAME INVENTION

It will be seen, therefore, that the question of diligence becomes exceedingly important when a second inventor enters the field.

Excuses for Lack of Diligence

Disabling sickness and great poverty will excuse apparent lack of diligence. Other excuses have been accepted at various times by the Patent Office, but to enumerate them here would be hurtful rather than helpful. An inventor may delay on sufficient cause in his own judgment, but it is the judgment of the Patent Office as to its sufficiency which will decide whether he or his adversary receives the patent. The Patent Office goes right to the heart of the proposition, and as it is right of one balanced against right of another, generosity to either would be injustice to the other. I cannot refrain from again, in this connection, calling to mind the facility with which a simple reduction to practice is effected in many cases and made securely of record and of its great value in establishing the inventor's rights.

Resume

(a) Diligence is not essential when there is no rival inventor.

(b) There is no way of positively knowing whether or not a rival inventor exists.

(c) The only safe rule is to use all diligence right from the beginning.

(d) First to conceive but last to reduce to practice, either by filing application or building of machine, will prevail if diligent.

(e) It is the judgment of the Patent Office, and not the inventor's own, that decides between him and his rival.

(f) The actual reduction to practice in a simple machine is often feasible and is potent in securing rights against rival inventors.

In connection with the recent widespread discussion that has taken place concerning the utilization of wood in the construction of mechanical apparatus, principally airships, it is interesting to note that the Forest Service has for some time past been conducting a large number of tests on many kinds of wood, in order to determine their strength, stiffness, elasticity, and other physical properties, so that they may be used to the best possible advantage in construction. Every species of wood has several different kinds of cells, each of which has its own size and form. The differences in structure have their bearing on the strength of the wood, and in order to arrive at a better knowledge of the conditions on which the strength of wood depends, the experiments embrace a microscopic examination of the wood after it breaks in a testing apparatus. It is expected that much valuable information will result from the investigation.

Machine Tool Selling in Japan

By Niri Yama

Anyone who has had occasion from time to time to visit the various arsenals, dock yards and railway shops throughout Japan finds that in all the shops English machinery predominates over American machinery. This, no doubt, is due to the fact that up to six or eight years ago there were hardly any American machinery agents represented in Japan, and up to that time nearly all machines specified were practically of English make.

The lathes that are used mostly in Japan at present are "gap" lathes, and it is very hard to convince some of the engineers that the standard American lathe is stiffer and easier to operate, and will produce more work than the gap lathe they have now in use. While there are a large number of American lathes in Japan, it is an exceedingly small number compared to those of English make, and the same holds good on nearly all classes of machinery.

The shop having the largest proportion of American machinery is the Shibaura Engineering Works, Tokyo. While this is not a very large plant, about 75 per cent. of the machinery installed is American made.

At the Tokyo military arsenal, where small arms and equipments are made, the percentage of American machinery is very small. When I called there I was informed that they had recently placed an order for something like 400 milling machines, which were ordered from England. When asked why they did not use a certain type, something on the Lincoln style, made in America, they replied that the catalogs which they had seen either showed too light or too heavy a machine. I then called their attention to a certain machine, showing a photograph of it, and the chief engineer said that had he known such a machine was on the market, after knowing the weight and capacity, no doubt the American manufacturer would have received the order. This is one mistake that is made by American manufacturers; they do not keep their agents posted enough on new designs of machinery as they come out, and the result is that orders are lost through this neglect.

During the war between Japan and Russia a complete plant of American machinery was installed at the Tokyo arsenal for manufacturing 3-inch projectiles and fuse parts, but this plant was placed in a separate building in the compound of the arsenal, and is kept entirely separate from the manufacturing of rifles.

At the Osaka arsenal, where they manufacture field guns and heavier ordnance, as well as projectiles of all sizes, the proportion of English machinery is very large compared with that of American make.

At the Kure naval station, which is the largest in Japan, they had installed during the last few years considerable American machinery, but still the quantity they have at present is very small compared with the English machinery installed and this is also true with the Yokosuka naval dock yard, which is the second largest in Japan.

While the Maidzura and Sasebo dock yards are very small compared with those at Kure and Yokosuka, the installation of machinery in the two places named is more English than American.

The proportion of English made machinery in the railway shops is far greater than in the arsenals or dock yards; in fact, one of the best laid out shops in Japan, the Nippon railway, had only three machines of American make when I last called at that factory, but since then they have installed several American machines.

There are several railways in Japan, including the Imperial Japan railway, Nippon railway, Sanyo railway, Kyushu and Hakodate railways. At present nearly all of these roads are controlled by the government, but the chief engineers at the various shops order the machinery required at their respective plants.

Outside of the arsenals, railways and dock yards there are a few large shops of prominence, namely, Mitsui Dockyard Company, which has shops at Nagasaki and Kobe, the Kawasaki Dockyard Company, whose works are at Kobe, and the Shibaura Engineering Works at Tokyo. The Imperial Steel Works, which is a government plant, is very large, and nearly all machines installed are of European make.

During 1904 there was shipped into Japan machinery and engines, not including locomotives, amounting to over 9,000,000 yen, and in 1905 a little over 20,000,000 yen; in 1906 there was a little in advance of 1905; 1907 and 1908 have not been quite so high. One yen is equal to 50 cents in American money, so it will be seen on the little island of Japan there is considerable business done in the line of machinery for the size of the island.

It is a great mistake with some American manufacturers to change their prices without notice in a place like Japan. In nearly all the government shops, they prepare their list several months ahead of time, and it is necessary for them to get quotations on machinery in order to put in a satisfactory list of cost of equipment required. When prices are changed, especially on the advance, it puts the engineers in a rather uncomfortable position with the officers in charge, as they expect to get the machines at the prices quoted and for which they have made arrangements. Therefore, it is well for manufacturers to give at least three months' notice to their representatives in Japan of the change in prices for the foregoing reason.

It is also essential that any manufacturers represented in Japan send their representing agents new data which may come out from time to time on new or improved machinery, as the Japanese at present are seeking to get the most uptodate machines to do their work. It is safe to say that the American machines at present are finding more favor with the Japanese workmen than ever before, and as soon as the Japanese are educated to the use of American machines, no doubt America will do as much if not more business in Japan than England.

A few years ago when Japan was specifying machines they would give the full specifications of all English-made machines; today they specify English- or American-made; but quite often we get beaten out on account of the lower price of the English machines. Moreover, if they wish to duplicate machines, and they have an English-made machine which is giving satisfaction in their factory, it is almost useless to try to induce them to take an American machine which they have not seen, as, feeling certain that the machine they have in their shop will do the work, they will not take chances on some other make. If the engineer happens to be a man who has seen some other machines then he may specify one or the other, or both.

It would be well for any American manufacturers who have a large line of machines to send a representative to Japan for a few months every two or three years, in order to go about with their agent and see if the machines of their make are being operated as they should to turn out work, and, no doubt, the chief engineers in the various shops would be delighted to have pointed out to them advantages to which the machines could be used, as the average Japanese is not so well up in the operating of American machines as the American. This would tend to increase the sales of American machines greatly, because at present there is hardly an agent in Japan who has a thorough mechanic in his employment who can go into the shops and operate the machines to advantage, if at all.

Regarding small tools such as drills, reamers, milling cutters, etc., there are one or two agents who carry a small stock. This leads nearly all the shops in Japan to make their own tools, or else they have to wait an interminable time before receiving what they desire. It would be well for any of our manufacturers of small tools to have their agents carry a full line in stock in Japan, and by so doing they could no doubt establish a large business.

American manufacturers who are represented in Japan should have their catalogs distributed among the various engineers, and they should have their representative send them a list of the different shops to which they have sent catalogs so that these could be followed up from time to

time with any new catalogs that may be issued.

There is no doubt that if American machinery is properly handled and pushed in Japan it will find favor, and in due time will replace a large number of English machines now installed there. Japan a few years ago was looking for cheap machinery, but today is looking for the best that can be obtained to produce good work.

Suggestions regarding shipping are unnecessary, as this information is always given to the manufacturer by the agent, but it might be well to know that there are two ways of shipping goods to Japan, overland and by the Suez canal. The overland shipping costs three or four times as much as by the canal. It takes for overland shipment from three to four weeks from New York, and by the Suez canal from six to eight weeks. The duty on machinery in Japan is about 15 per cent.

It is sometimes necessary in Japan for two agents or representatives to work together. Occasionally an agent gets an inquiry for certain machines which he does not represent directly, and if the party representing such machines does not work with the agent who has the inquiry, quite often the parties giving the inquiry will be induced to use some other machine, whereby the one representing the original machine specified will lose the order and also the good feeling of the other agent. However, it is not well for the manufacturer to give prices to various agents, but let the agents work from their representative in Japan.

All machines shipped to Japan should be inspected thoroughly, and be in perfect condition before shipping as the Japanese criticize machinery very much that is not up to the standard, and it is certainly a long way to ship a machine back which is not correct, besides losing the good will of the purchaser; so if anything is wrong with a machine the manufacturer should be sure that it is rectified before allowing it to leave the factory.

In order for American manufacturers to get their machines well installed in Japan they should be governed in price by their competitors, as when Japanese specify for machinery, nine times out of ten they take the lowest bidder, and as they specify three or four different makes they have competition and a variety to choose from, and as far as possible the manufacturer should give the agent privilege, only when absolutely necessary to secure the order, to go a little below standard prices.

It is impossible to secure any photographs of the arsenals or dockyards as the Japanese government will not permit anyone to use a camera within several miles radius of any of the above named places.

Ingenious Automatic Cut-off for a Rope Drive

EDITORIAL CORRESPONDENCE

The W. F. & John Barnes Company, of Rockford, Ill., having a limited space in which to locate their heating apparatus, were forced to put a rope drive between their engine and blower, as shown in Fig. 1.

In order to take up the slack of the rope caused by its natural stretch or the changes in atmospheric conditions, one strand of the rope was carried over a sheave wheel on the carriage *A*, which is located on a track above the engine. The weights *B* were hung on a rope that was passed through the pulley *C* and attached to the carriage *A*. This keeps the proper tension on the rope drive.

As the engine was not watched very closely, but was left to run itself, there was danger of the rope breaking which would cause the engine to run away when relieved of its load. To overcome this an ingenious arrangement of sprockets *D*, *E*, *F* and *G*, with their chains and rods, was rigged up. If the rope, in the drive, broke, the carriage *A* would be run back to the fork *H* by the weights *B*. The carriage striking the fork *H* would move the rod levers *I* and *J* and these in turn

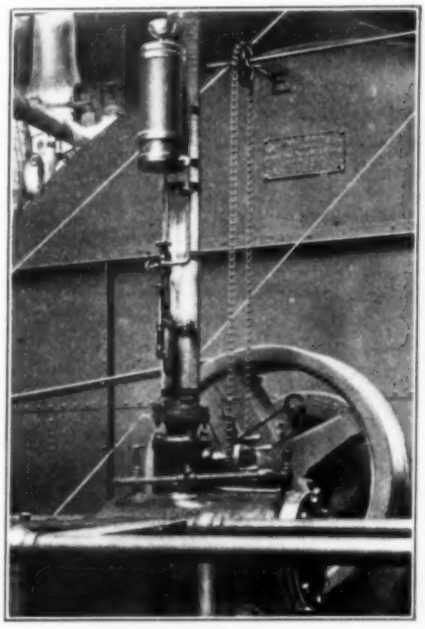


FIG. 2. CONNECTION ON THROTTLE

would release the sprocket wheel *D* and its shaft, which would allow the weight *K*, that is fastened to the chain, to drop to the bottom of the sprocket wheel *F*. When the weight *K* drops it carries the chain with it and transmits this motion back to the throttle at *G*, Fig. 2, thus closing the throttle and cutting off the steam, which will cause the engine to stop.

This is a simple and cheap rigging that can be easily installed, but it does its work perfectly and might be useful to others if placed in a similar position through lack of space.

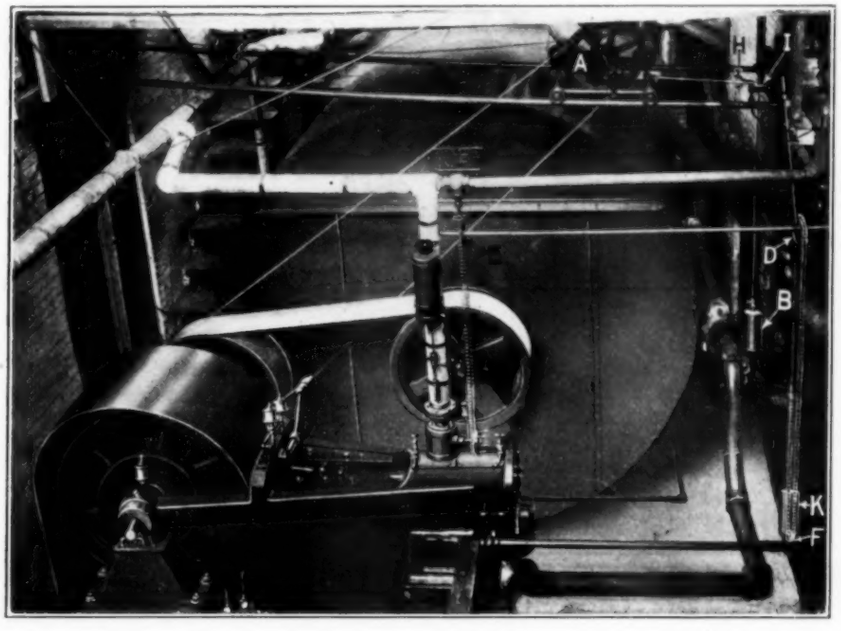


FIG. 1. APPARATUS FOR CUTTING OFF THE ENGINE AND TAKING UP SLACK ON A ROPE DRIVE

The cost of the Panama Canal to the United States up to June 1, 1908, represents $72,948,007, which does not include the purchase price of the French undertaking, and is exclusive of the indemnity. The amount expended is divided as follows: Engineering and construction, $28,332,966; plant, $30,102,334; improvements, $5,646,349; sanitation measures, $6,720,843. The remaining two million odd dollars is covered by civil administration expenses.

Practical Letters From Our Readers

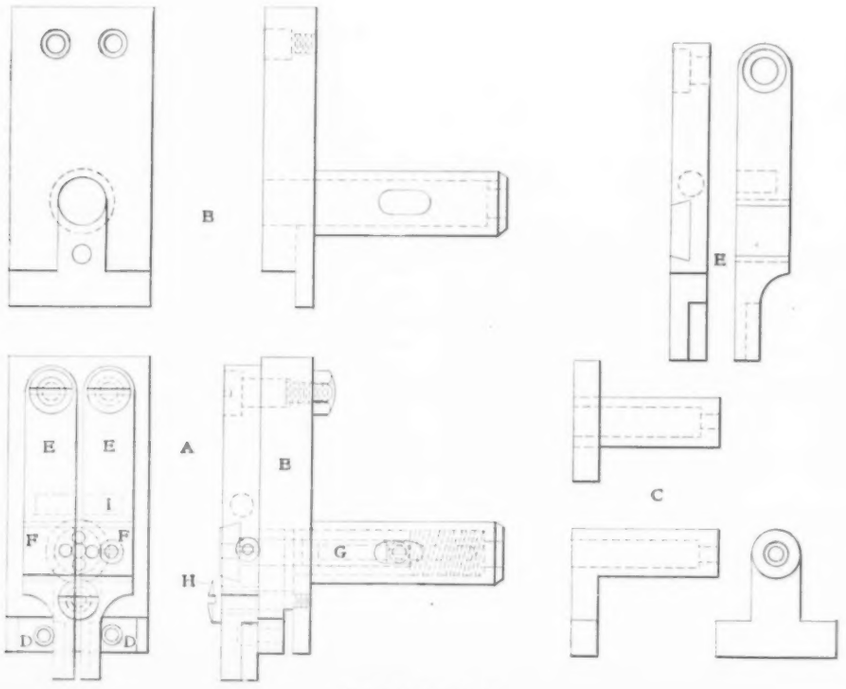
A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

Self-opening Die

I designed this die head for threading long stems for terminals and other posts used on electrical apparatus where a long threaded piece was required, and found it worked all right. It was then tried on long screws, but when trying to cut them right up to the head, I got into trouble as the chips got in between the head and die, so it would not open; but for screws where it is not essential that the thread should be cut dead up to the head (say one thread away) it answered very well. It is not an expensive tool to make and the die can be easily made on the interchangeable system. The main piece can be of mild steel case hardened. *A* is the holder assembled ready for use. The springs are not shown in the jaws or levers. *B* is the body with a shank to fit the capstan head. Two holes are counterbored and tapped for the studs and the bottom of the body is machined for the releasing plug or stop *C* which is fitted in the recess in the shank. The two wings on *C* are for the two hardened studs *D* that lock the jaws *E* when closed. These jaws or levers are machined to receive the die members *F* which are adjusted by the screws at the ends and then secured by the clamping screw. Through the releasing member *C* a hole is bored for the adjustable stop *G* which gages the length of the thread to cut. The slot in the shank allows the clamp screw to be tightened when the stop is set. The spring in the shank is for pushing the stop *D D* over the arms *F* when they are closed which may be done by passing the device between two cam plates when the turret is being rotated; or when threading certain work it is usual to close them by hand. The long screw *H* is to keep jaws *F* flat against the holder. The hole at *I* receives the spiral spring for forcing jaws *F* open; the ends of these jaws are milled away so as to leave only a short gripping surface for the pins and the shoulders thus formed serve to keep the jaws from opening too wide.

London, E. C. C. PETITJEAN.



SELF-OPENING DIE

A Draftsman's Precision Needle Point

In the great majority of cases the draftsman, who buys his instruments as produced by the maker, finds that they serve every purpose. Now and then, however, he is called upon for work that demands more than the ordinary degree of accuracy and refinement. It is for these jobs that I wish to describe the precision needle point.

The ideal point is one which makes the smallest possible hole in the paper consistent with strength and durability, and that has some provision for preventing its working down deeper and deeper into the paper where a number of circles have to be drawn from one center. As commonly made, they are like Fig. 1, in which the body of the needle point is turned down

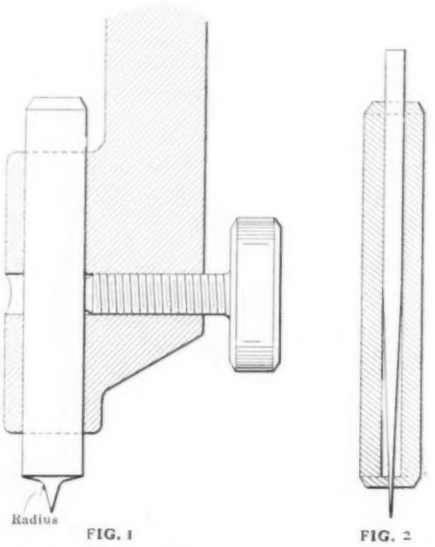


FIG. 1 FIG. 2

THE ORDINARY AND A PRECISION DRAFTSMAN'S NEEDLE POINT

at the end and filed as sharp as may be, having a little round fillet to help strengthen it. It is impossible to get this point properly hardened and if made strong enough to be of service it makes a large hole in the paper.

The ideal point is shown in Fig. 2, in which the needle itself is a separate piece and driven into the body. You can insure an absolutely square shoulder at *A*, and a properly hardened and tempered needle. The needle, which is a common sewing needle, will last forever and never get dull or bent over. I have had four or five of these points in constant use for four years and have never had one break or loosen up. In my beam compass, which probably has the heaviest duty, the needle itself is 0.020 inch in diameter and the body is 0.080 inch, the point projects 0.020 inch beyond the body. In my smallest bow pencil the needle is 0.020 inch in diameter and the diameter of the body is 0.042 inch.

The difficulty of making this kind of needle point is not so great as may appear. A short piece of drill rod 0.042 inch

in diameter is taken and a hole 0.020 inch in diameter drilled down the center to within about 0.010 inch of the end. The needle, which is broken off to the proper length is then inserted in the hole and a few blows with the hammer will make it pierce through to the required length. It can then be removed, the bur around the edge of the hole taken off with a stone and the needle driven back to stay.

EDWARD S. MC. ALL.

Syracuse, N. Y.

Taper Gages

At page 458, Vol. 31, Part 1, there appeared in your columns an excellent article by C. C. Stutz describing a taper gage and the use of two disks of varying size in setting the gage accurately to the required taper. It recalled my own experience in this line and the idea also occurred to me that the principle and formulas used might be readily applied to measuring taper holes to which taper plugs were to be fitted, by substituting spherical balls for the disks, pushing them into the taper socket alternately as far as they would go and finding the distance between their centers by measuring their relative positions from the face of the spindle with a depth gage.

The accompanying sketches show a more convenient way of accomplishing the same results, and also a taper gage for male tapers which is of light, compact form and may be handled almost as readily as an ordinary snap gage or caliper.

I had occasion to make these gages and put them into use, some time ago, in a large factory, the spindles of whose machine equipment had a diversity of standard and mongrel tapers, where there were no taper plug or sleeve gages, and where a large number of special tools, centers, cutters, etc., had to be made to fit the various machines in different parts of the plant at points distant from the tool department.

"CUT AND TRY" METHODS

The practice had always been, in common with many other shops, to "take down" the machines and send the spindle to the tool department to be fitted. In busy times (and the shop was always behind time trying to catch up), this resulted in the "tie up" of other work, for which the machines were required, while making and fitting the taper to the spindle by the "cut and try" method.

This was rather a serious matter and caused considerable comment over delays and the alleged slowness of the toolmakers, by the department in which the work was delayed and by the office. Therefore, to eliminate friction, loss of time, expense and to gain the good will of everyone affected, I planned the following methods and designed the gages shown in the sketches, as a solution of the problem:

USING THE GAGING DISKS

Referring to the sketch, Fig. 1, the way the gage is used is to select three washers *III* from a set varying by sixty-fourths in diameter for the smaller sizes, and thirty-seconds and sixteenths in the larger sizes. The smallest one chosen should ordinarily be the next size larger than the diameter of the small end of the taper hole, and is used on the gage at *B;* one which is the next size smaller than the large end of the taper is used at *C;* and one which is large enough to give a good bearing on the end of the spindle is used at *D* to determine the proper relation of diameter to angle. If necessary to have *C* closer to *D*, the sliding head which carries *D* may be reversed. The sliding head carrying *C*, however, if reversed and pressed snugly in a dry spindle is apt to stick and slip, which will not occur when used in the position shown.

The two friction sliding heads *C* and *D*, after the taper hole has been slightly oiled, as a precaution against sticking, are roughly positioned as if to gage a shorter taper and then inserted in the hole and hand pressure brought to bear against *E* until all the washers *I* are seated on the spindle *A*, as shown in Fig. 1.

It is then withdrawn and we have a skeleton replica of the female taper, giving the diameters at two points and their relation to the end of the spindle.

SETTING THE LATHE TO THE GAGE

This gage was first used by itself, plac-

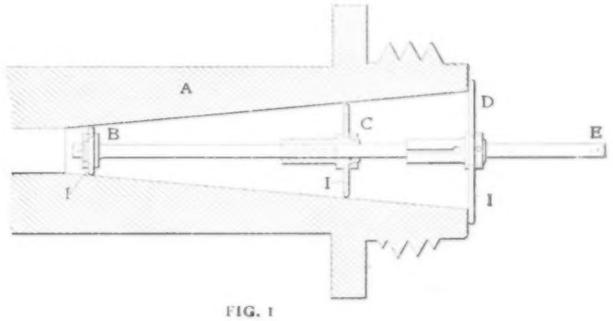


FIG. 1

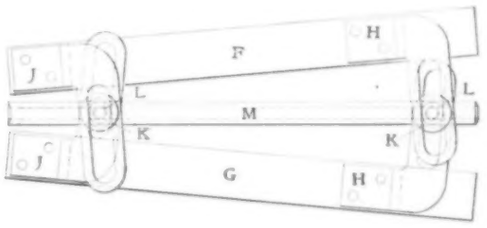


FIG. 2

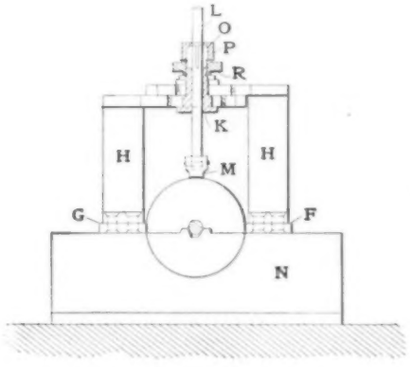


FIG. 3

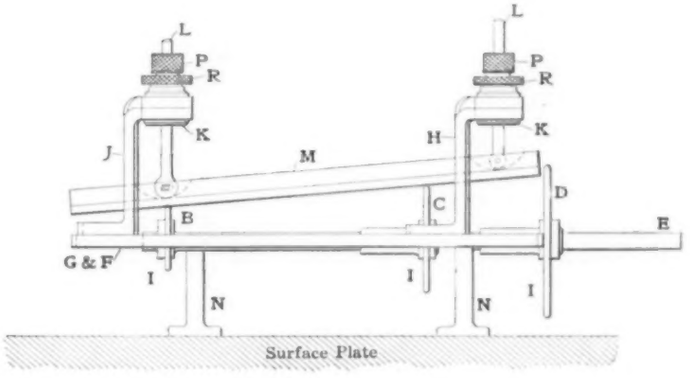


FIG. 4

TAPER GAGES

ing it between centers in the lathe and setting the taper attachment so the lathe tool would just touch washers on *B* and *C* with one setting of the cross-slide.

The tool or center requiring the taper shank was then put in the lathe and turned to size, measuring with a caliper or micrometer, set to the washer at *C*, at sufficient distance from the large end to insure the necessary projection of the finished tool from the face of the spindle. This distance was found by measuring the space from the washer at *C* to the washer at *D* with a scale and adding the required amount.

This method gave very good results, often giving an accurate fit, but occasionally requiring a little fine filing or polishing with emery cloth for a final fitting which generally could be done "on the spot," that is, in some speed lathe nearby, without returning to the tool department.

However, it became apparent, finally, that further refinement was necessary and was warranted, especially on duplicate work and on some jobs where the variation in projection from the spindles was objectionable, and for this reason the female taper gage with center blocks, shown in Figs. 2, 3 and 4 was made.

It was also afterward found that by the use of this latter gage the quality of the work was so much improved as practically to eliminate the necessity of any final fitting of the work at the spindles.

Construction of the New Gage

Referring to Figs. 2, 3 and 4, this gage consists of two parallels, *F* and *G*, each riveted to two slotted angle brackets *H* and *J*, which give an independent adjustment of each end of *F* and *G*, and allow them to be set to various tapers and to be clamped in position by stud *K* and nut *R*. The third straight edge or parallel *M* is also independently and vertically adjustable at either end by means of hinged pins *L*, one of which has a horizontal slot for the hinge pin to allow for slight changes in the center distance, when setting to different tapers between the hollow studs *K*, in which they are clamped by means of the taper nuts *P* and the split end of *K* at *O*.

As may be seen, parallels *F* and *G* could be readily set by Mr. Stutz' system, but the method of setting planned and used was to adjust the skeleton male gage, Fig. 1, to the spindle as before, set it into the special center blocks *N*, Figs. 3 and 4, and then place the female gage in the position shown with the ends of the parallels *F* and *G* against the washer at *D*.

Then by swinging the parallels against washers at *B* and *C* and clamping the studs *K* and the pins *L*, we have a skeleton duplicate of the spindle taper, giving the angle and the size at the large end of the taper. The male gage is then placed between centers as before, but with the female gage in position on it, turning it until parallels *F* and *G* are in a horizontal position. The taper attachment is then much more readily and accurately set by using the latter tool, or an indicator gage, set at center, along the outside edge of the gage parallel *F* instead of by the former method of setting by the washers on *B* and *C*.

After placing the work in the lathe the female taper gage is used as a caliper, and the piece is turned and reduced until a proper fit is obtained, with the work projecting beyond the ends of the gage parallels *F* and *G*, the same amount as it should project from the spindle.

Tapers made in this way were finished without any final fitting to the spindle and gave an accurate fit.

Other Applications of the Gage

We also pack harden and grind many tools with taper shanks now, and find this gage invaluable in setting the grinding machine and gaging the ground work. To swing the grinding-machine table to the right angle, we set the gages between centers as in the lathe and set by an indicator gage clamped to the wheel hood.

In duplicating male tapers, where it was possible to obtain an accurate part, the gage was set directly to this part instead of setting to the male skeleton gage. This, unless carefully looked into, however, was not a safe procedure as we have come across many cases where the original centers, sold with machines, were not first-class fits and also where the taper sockets in the line and tail spindles, while the same size, varied enough to require independent gaging and fitting.

Accurate Workmanship

In making both the male and female gages described, great care was used in getting all the important members true and square.

Practically all the parts were pack-hardened. Washers *I* were ground in a magnetic chuck on the sides, the holes lapped to size, and then placed on a special arbor and ground true on the outside. Heads *C* and *D* were lapped in the hole, while the slots were opened slightly with little wedges to a close sliding fit on *E*, and were then ground true to a snug fit at the washer seats on an arbor. Removing the little wedges gave the required friction on *E*. Gage spindle *F* had its centers well polished, was ground and lapped its entire length and ground in its washer seat.

In the female gage, parallels *F* and *G* were ground all over, parallel *M* was ground on its lower face and the pins *L* were lapped fits in studs *K*, which were also ground true under the head. Angle brackets *H* and *J* were first ground on both top and bottom sides of their slotted ends, then they were clamped together, as shown in the sketch, to a plane surface on the surface-grinder table by means of two screws through the slots. The bottoms, where riveted to *F* and *G*, were then ground in pairs.

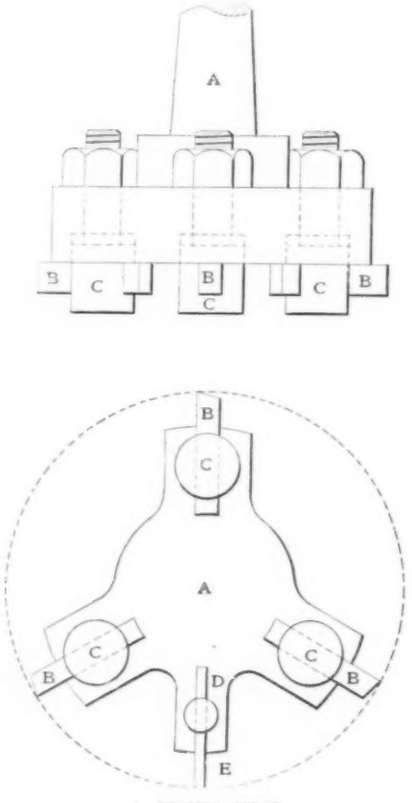
Center blocks *N N* were ground on the bottoms, then clamped to a parallel block, and ground on the top surfaces and V's as one piece.

While it may appear to some that too much care was expended in making this gage accurately, I have felt amply repaid, by the results, by the smooth working of the gage itself and by the respect that the toolmakers have for it, for the extra expense and atention given it.

Camden, N. J. L. E. Dudley.

A Three Tool Boring Head which Can be Calipered

The boring head shown in the illustration suggested itself to me recently. *A* is the body of the tool made of any suitable material. If of cast iron a machine-steel crank with centers in the ends should be rigidly fitted to it. *B* are the three tools held, as shown. The slotted bolts *C* having feathers or other means to prevent them from turning with the nuts. An extra bolt *D* is fitted opposite one of the tools. This bolt need not be as large as the others, its object being merely to hold the piece of tool steel *E*, which is ground at the same time the tools *B* are being ground, with the head mounted between centers and the tools secured. This piece



A BORING HEAD

E permits the head to be calipered, and when the desired size is reached the bolt *D* and piece *E* are removed. The cutters *B* are then backed off in place and the head is ready for business. I have never seen this rig tried, but I see no reason why it should not work.

Where heavy boring is to be done the bottom of *A* should be slotted radially the same size as the tools. This will effectually prevent the bolts *C* twisting, and is easier to fit than a feather and spline on the bolt, and at the same time much stronger.

New York. E. A. DIXIE.

Device for Revolving Gears in a Hardening Furnace

After considerable expensive experimenting on the hardening of transmission gears, we have found that the warping of the gears is due as much to uneven heating as to uneven cooling. It has been found to be almost next to impossible to maintain an exactly uniform temperature throughout the interior of the oven, especially when the door has to be opened occasionally to take out those gears which have been heated to the right point for quenching.

To overcome this one automobile factory, which manufactures its own transmission gears, has made the device shown herewith. This fixture causes the gears to be evenly heated by constantly revolving them in the furnace. When the gears are heated in that manner, and are properly quenched, the warping, which heretofore caused so much annoyance, has been almost entirely overcome.

The construction and working of the fixture is as follows:

As shown in Fig. 1 an ordinary oil furnace is used, upon which to build the fixture. The box-shaped casting *A*, Figs. 1 and 2, is bolted on the under side of the bottom plate *B* of the furnace. This casting *A* answers as a casing for the mechanism which revolves the gears in the furnace above. The main spindle *C*, Fig. 1, is revolved by the bevel gears *D* and *E*, *E* being connected to a countershaft by a pulley on the outer end of the shaft *F*. All the shafts in the casing are run vertically and consequently are placed on ball thrust bearings.

The shaft *C* has a washer and retainer form of bearing *N* and is supported at the top end by the bearing *G*. This central

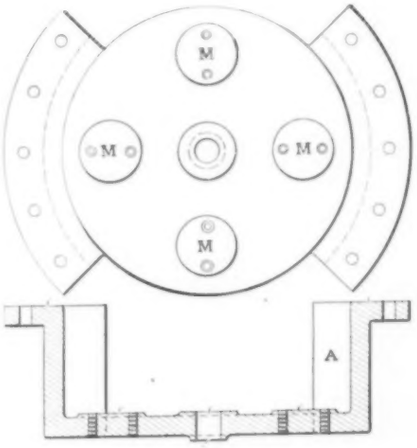


FIG. 2. CASTING FOR HOLDING REVOLVING MECHANISM

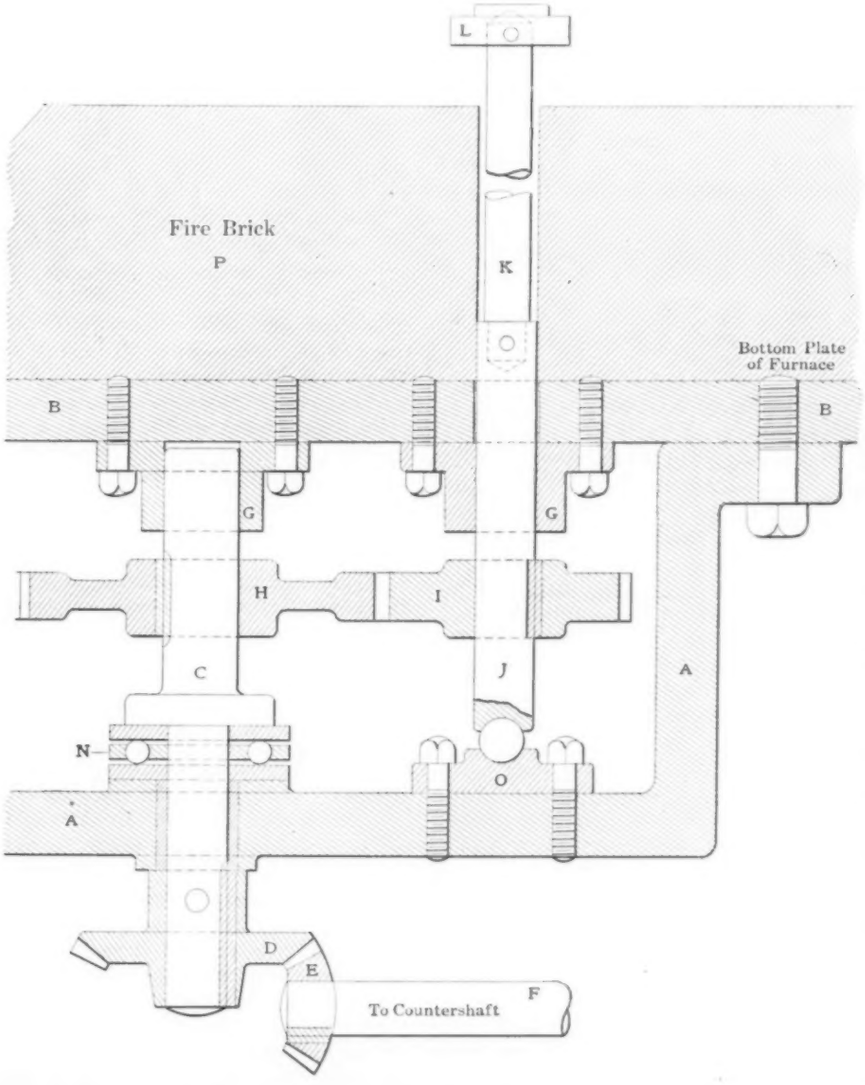


FIG. 1. DEVICE FOR REVOLVING GEARS WHILE HARDENING IN A FURNACE

shaft *C* carries the central gear *H*, with 48 teeth, and this meshes into the four smaller gears *I*, with 32 teeth, whose positions are shown in Fig. 2 at *M*, *M*, *M*, *M*. The smaller gears *I* revolve the four vertical shafts *J* which are supported by single ball bearings seated in hardened-steel cups *O*.

The parts *K* and *L* are connected with the four vertical shafts and are revolved with them. The part *K* extends through the bottom plate *B* of the furnace, and on up through the firebrick *P*. The part *L* is a button-shaped piece upon which the gears to be heated are put while in the furnace.

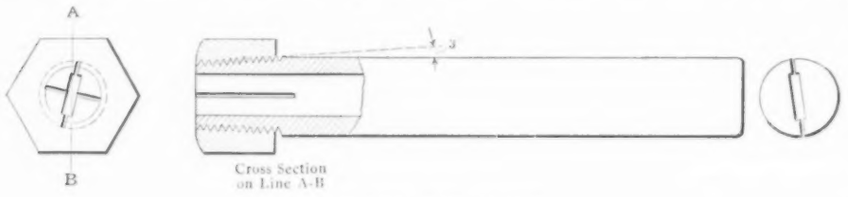
The gears which are being heated are not fastened down in any way but are simply rested on the button-shaped pieces *L*. In this way they are quickly inserted and quickly removed from the furnace by the tongs.

The shafts *K* are revolved at about 12 to 18 revolutions per minute. The parts *K* and *L* which come in continual contact with the heat of the furnace are made of nickel alloy. This composition stands the heat very well and answers admirably where steel would soon be destroyed. Any shop can build one of these fixtures and it is sure to pay for itself many times by the number of gears it will save. The original fixture for which these drawings were made has been in actual service night and day for nearly a year and a half. It requires practically no attention and very little repairs, and we consider it a money saver.

Washington, D. C. R. B. LOVEJOY.

A Threading Tool Holder

The tool holder shown on the inclosed blueprint is to be used with any of the many tool-post devices for holding round tools. It can be used for cutting-off tools, but was designed especially for thread



A THREADING TOOL HOLDER

cutting. It is easy to use the same tool for right- and left-hand threads with a minimum amount of side clearance, and it leaves the tool very strong, as the holder can be rotated in the clamping device for any angle. The clamping nut holds the cutting tool solidly close up to the work, the bar being split through the threaded part horizontally as well as vertically.

Watervliet, N. Y. M. H. BALL.

Glazing of Cast Iron under Water

In experimenting with the use of a hack saw under water, using regular hack-saw blades, we find that with cast iron the surface seems to become glazed, so that the saw does not bite, but simply slides over the metal. Has anyone else had a similar experience, and what is the reason?

Burlington, N. J. JOHN JOHNSTON.

Ring Making in the Punch Press

The accompanying drawings are of a pair of tools for the punch press. They produce at one blow a ring that it formerly took two blows to form, and as the second operation was done in a pair of toggle tools, the stripping from the punch was done by hand. Thus the new tool effected a big saving.

The cycle of operations was as follows: The stock, which was of soft brass 0.378 inch wide by 0.031 inch thick, was fed by the operator, through the slot *A*, up to the stop *B*. The punch in descending cut off the blank with the cutting edges *C*. At the instant the stock was severed the mandrel *D* bent, or raised the blank into the form of a U. The mandrel *D* was mounted in a sliding piece *E* which, as the mandrel reached the bottom of the die, recedes into the punch proper *F*, thus allowing the punch to gather the ends of the blank together and complete the rounding of the ring. On the upward stroke of the press the ring is stripped from the mandrel by the spring-actuated stripper *G*. This is actuated, as shown by the two plates *H* which are fixed at the back of the bolster *I*. The incline of these plates engages with the horns of plate *J* and so makes the stripper travel forward on the upward stroke of the press, and backward on the downward stroke. As the rings were stripped from the mandrel they dropped into a chute which led to a pan under the press.

From inspection of the line cut of the lower part of the tools it will be seen that the slot *A* through which the stock is fed, is formed in the upper part of a plunger. By this means the stock was held as in a vise during a greater part of the stroke, and could only be fed forward when the punch was on the upward stroke and the stripper was about to commence the stripping operation. This slot was the only gage or guide required besides the stop *B*, and it was this plunger which allowed the press to run continuously. The operator's only business was to feed the stock forward.

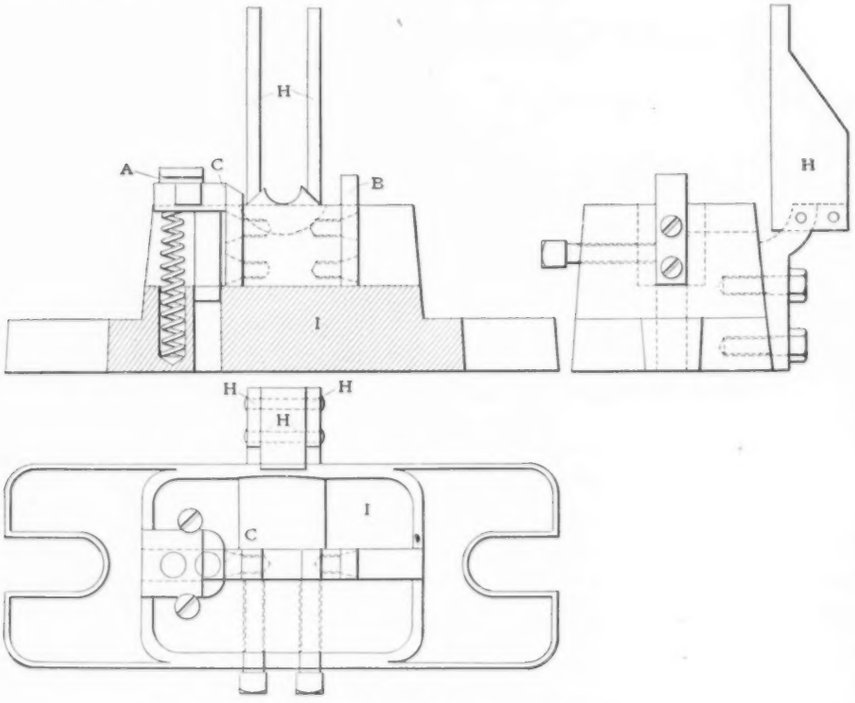


FIG. 1. LOWER PART OF TOOLS FOR RING MAKING

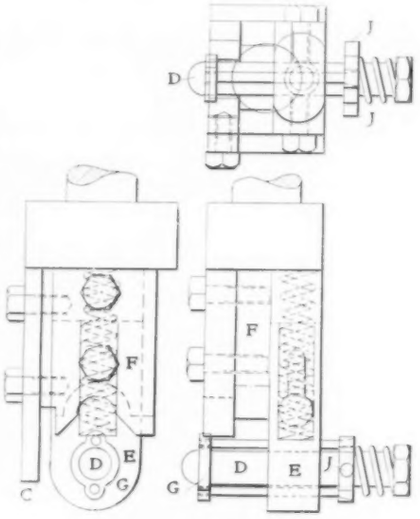


FIG. 2. UPPER PART OF TOOLS

The die was made, and the cutting members as well as the stop *B*, were screwed to it, as shown, to facilitate grinding and repairs.

In like manner the punch proper, of tool steel, was screwed to the punch holder, of mild steel, and the cutting member of the punch was screwed to the punch proper.

Birmingham, Eng. JOE BROWN.

An ingenious machine has been invented by means of which sound, according to the *Engineer and Iron Trades Advertiser*, can be visualised. All sound comes from air vibrations, which radiate from the center of a circle, just as when a stone is thrown into a still pond the water vibrates into little waves. The air waves of sound are, however, invisible, and though they can be measured they cannot be seen. By using a small flame and rapidly rotating mirrors, Brewer Brown, the inventor, is able to show a continuous picture of the vibrations caused by the human voice, which vary, of course, according to the note sounded.

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

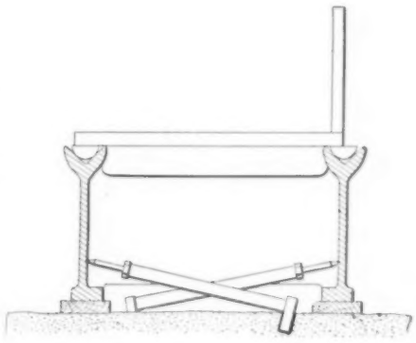
Leveling and Alining Planers

Mr. Thompson's article at page 581, on the leveling and alining of planers, reminded me that it was once my job to keep a planer of the same size, but even longer, sufficiently in line so that the work done on it could be called true. This planer was set on the edge of a swamp. That is, one end set where there was a good gravel foundation overlaid with about 6 inches of compressed peat, which in turn carried a filling of brickbats, ashes, tin cans, etc., compacted into a sort of heterogeneous concrete. The other end was practically over where the brook used to run, and where piles had been driven 30 feet without hitting anything hard. To put a long planer on such a foundation was, of course, foolish, but like lots of other foolish things, it had been done. Excavation had been made the whole length of the bed, about 75 feet, and stones about 6 or 7 feet long had been laid down and leveled up. Then 2-inch chestnut planks were laid on these stones, lengthwise of the planer, and bedded in cement mortar. The planer bed was set on these planks. No provision whatever had been made to allow for the lining up of the planer in case the foundation settled.

About my time it was decided that the planer was in need of leveling, to reduce the corkscrew effect which was being found in some lathe beds which had been planed on it. The leveling was easy if we could find out where we wanted to level. All that was necessary was a liberal supply of broad, thin wedges to drive between the plank and the bottom of the bed. The sideways alinement was the most serious and the most necessary. There was no chance for these modern leveling blocks, if we had known about them. We put in diagonal jacks as shown in the section, Fig. 1, resting against pins set in the stone foundation, and into little notches chipped into the inside of the planer bed. Six pairs of these were used.

Leveling

To level up the bed we first turned four cylinders about 4 inches in diameter closely to the same size. We leveled from one to another lengthwise and crosswise of the bed, until we reached a point close to the middle of the bed, when we discovered two things; one that no amount of wedging up of the bed would take out the sag here, for the simple reason that the bed would lift off the other wedges, and the other that at the center of the bed the level would not stand the same with the table at one end of the bed, that it did with the table at the other end of the stroke. We found that the bed was worn so much that we could not wedge the wear out of it. We found, however, that this excessive wear was confined to about 6 or 8 feet in the center, so we came to the conclusion that if we avoided using that 6 or 8 feet of the table, which was something over 40 feet long, we might ultimately wear the rest down to the same level as the center. This wear, by the way, did not exceed 0.003 inch. If it had been uniformly varying toward



ARRANGEMENT OF JACKS AND LEVELING BLOCKS FOR A PLANER

the end of the machine we could have sprung it out easily.

The fact that it was so concentrated we laid to the fact that the machine had been used a great deal on short stroke, and with some heavy work near the end of the table.

After leveling up the bed as best we could with these rolls in the vees we went over it with the level laid crosswise on the platen. We found, though not unexpected, that the level on the platen did not show the same as on the bed due to two things; one, that our rolls had only line contact with the vees and if that line happened to occur where there was considerable wear then the cylinder would fall lower than the platen; the other, and more elusive, reason was that a "hump" in one vee of the bed would at certain places throw the end of the table up and off the vee altogether as we found by pushing thin shims under the vee of the platen. We had to go over the whole thing again and level out these bunches, being careful not to run the end of the table over the worn spot in the center of the bed. We found that this was much more delicate work than our first job, because a very slight bunch, that we could not detect directly with the level, would in certain positions of the table throw it out quite perceptibly.

Alining

The lining of the table in a horizontal plane was done with a wire and two half-round blocks at first. Two were put in the ends of one vee and a fine wire set up and plumbed to stand over their centers. Then one of them was slid along the bed and plumbed from the wire. The plumbing was done, as indicated in Fig. 1, by means of a third block just like the other two and our big square which rested on the two blocks, with its tongue brought against the wire by jacking the bed over, being careful about the low spot in the center. After lining the bed in this way we ran the table back and forth on the bed and used a distance piece between the edge of the table (one spot only) and the wire in a new position. This was done to avoid any inaccuracies due to the half-round blocks resting in locally worn spots, and did not usually happen to show much variation. We then took a light cut down one side of the platen and tested it for straightness in different positions along on the bed, using the distance piece as before.

The patience required on a job of this kind on an old and partly worn machine is something that it is hard to make people believe. We were successful, however, but, of course, could not make the foundation stay in any one place; consequently we had to go over it at least once a year.

ENTROPY.

Springfield, Mass.

How to Flatten Punched Blanks

On page 753, Geo. Wilson asks how to straighten punched blanks.

The editor's footnote advising to have the dies made correctly is, of course, the first step.

The metal punched is No. 17 sheet brass and for this thickness of metal no straightening should be necessary.

The punch and die should be a perfect fit, cutting face of punch absolutely square and ground flat; very little clearance in the die, ½ degree or less. Shear, if any, should be on the die and both punch and die should be kept sharp and in good condition.

If these precautions are taken, the work will not require any straightening, pro-

vided that the brass strips from which the punchings are made are not in coil or roll form.

Frequently it is a very hard matter to obtain flat blanks if the stock is in coils hard or semi-hard brass and for such requirements only flat lengths should be used.

On heavier blanks, ⅛ inch thick and over; 3 inches and over largest dimensions and principally of cold-rolled steel, the blanks sometimes require flattening and the best and quickest way to straighten them is, as far as the writer knows, under the drop hammer.

However, in this case, as the editor says, the question is probably more in the making and use of the dies and punches and the thickness of the stock to be flattened apart. With a press running 60 strokes a minute an operator can get a blank under pretty nearly every stroke of the press. This process will flatten blanks accurately and cheaply.

PAUL W. ABBOTT.

Wilkes-Barre, Penn.

An Old-time New England Machinist, Seth Wilmarth, Union Works, Boston

The article under the above caption at page 163 was of considerable interest to me, for I have in my possession a number of drawings made by and also under the direction of Seth Wilmarth when he was in charge of the machine shop at Charlestown navy yard.

That old shop at South Boston must have turned out a lot of work in its day and the superiority of the work is attested to by the fact that many Union Works tools are to be found still in commission in numerous shops throughout New England. There is rather too much polished work about these tools as judged from our standards today, but in those days there was quite a weakness, displayed by the designers, for polished work and fancy moldings, such as one sees adorning cathedral windows. The housings of the planers were, as a general thing, rather slender, as were also the beds of the lathes.

There was, until a few years ago, a planer in the Charlestown navy yard designed by Seth Wilmarth, which is said to have been capable of planing a piece 18 feet wide, 14 feet high and over 20 feet in length. There were several features of interest in this old planer. Both the driving and feeding mechanisms utilized friction cones of wood screwed to iron bodies. After the planer was built wash drawings were made and the tool was considered of sufficient interest to have a number of lithographs made from the wash drawings.

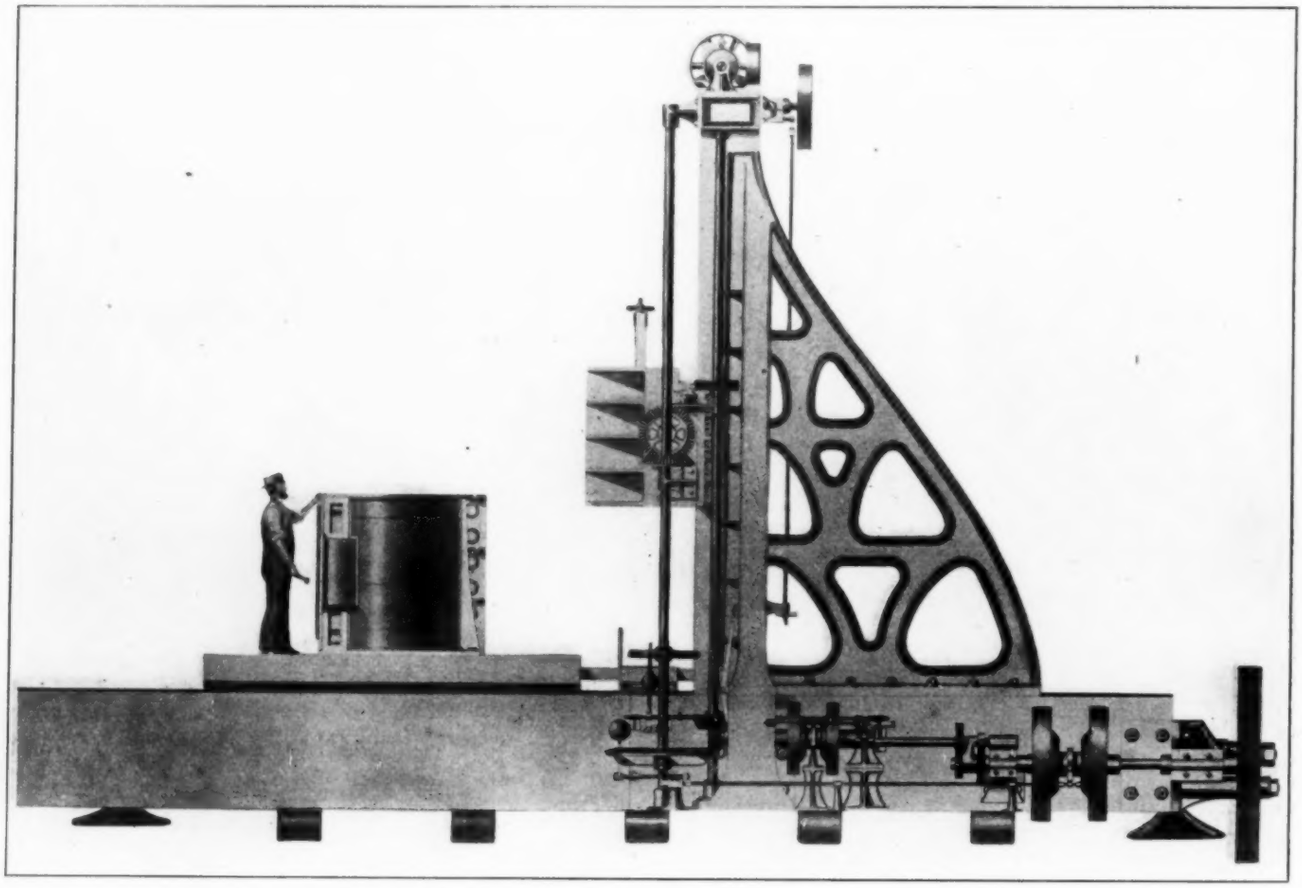


FIG. 1. SIDE VIEW OF SETH WILMARTH PLANER

The half-tones, Figs. 1 and 2, are reproduced from these wash drawings and show, respectively, side and end views of the planer. The frictions appear as four disks in groups of two on the side view, Fig. 1. The small pair for the feed is below the housing and near the front of it, while the driving frictions are below the rear end of the housing. The man in both views is, I am told, intended for Seth Wilmarth himself. Taking this man's hight as 6 feet we can see this planer would take at least 14 feet under the cross-rail. The shortness of the table is a feature which appears peculiar, but I could not get any information of a

George Wilson should first investigate this.

It frequently pays on work of this kind to make padded dies and this will often overcome the trouble on very thin stock.

Rome, N. Y. L. F. C. GEORGE.

In answer to Mr. Wilson's question on page 753 as to how punch-press blanks are flattened, the usual practice in punch-press departments is to pass the blanks through a press which has in place of the punch and die two hardened blanks which are ground perfectly flat on their faces. The press is set so that on the lowest point of the stroke the flat surfaces are

definite character regarding the length of the table. One man said the table shown was cast in two pieces, which were bolted together in the center between the V's, and another said that a similar table was subsequently made and bolted to the end of the first one.

The table was driven through the friction cones already referred to which actuated the screw between the V's. The tool slide was provided with a hand-feed arrangement, which we see on many large planers of modern construction. The V's were very obtuse. This raises the question, why were the V's made so obtuse on a planer, and so acute on the beds of the Seth Wilmarth lathes?

Both elevating screws were the same, which I think will be admitted to be good practice providing they were cut on the same lathe and the same part of the bed so that whatever errors were in the lead screw would be in the same part of each elevating screw. The reversing lever is provided with a ball to help throw it over the center. This feature was quite common with planers built at that time both here and abroad. As Entropy put it once was "just at a handy hight to break the operator's leg" if he was not careful.

New York. E. A. DIXIE.

Annealing Tool Steel

In reading a back number of the AMERICAN MACHINIST I was struck with the remarkable admission made by the writer of the article on twist drills that "a large proportion of drills were not straight after hardening and tempering." I think with care and the following suggestions that the amount not straight could be reduced to a minimum.

All practical men know that tool steel undergoes great changes in annealing and hardening. If you take a piece of steel 1¼ inches diameter and 10 inches long for a double square-thread tap, then carefully anneal and well cover it in lime, and when cold turn it to within 1/16 inch of the finished size, in 11 cases out of 12 it would not be perfectly straight and true.

If after it had been rough turned you had put it in a tube, in a hollow fire or furnace, and carefully heat-treated it as before, you would take out all the irregularities, and remove the strains that cause warping.

I have hardened double and treble square-thread taps in this way with perfect success, and if the time can be spared, even to anneal the third time is beneficial. This also applies to every tool of complicated shape, as there is not near enough attention paid to annealing. It is time well spent, and I venture to say that with a good make of steel that part of shops set apart for straightening in large works could be almost dispensed with, and the tools would last longer, because of greater uniformity.

Again, in straightening tempered tools, heating here and there, ever so little, causes undue strains and often the start of a fracture, and men get blamed for breakages due to improper treatment.

London, Eng. EDWARD CRUMP.

The forward movement Japan is taking in the machinery line is reflected in a newspaper despatch from Kobe in which it is stated that the department of agriculture and commerce has been encouraging the manufacture of various articles by letting out new machinery brought from abroad to private factories. This measure is said to have proved a success, and the authorities have decided to extend the practice. With this object in view the department is to purchase machinery of all kinds for the purpose of manufacturing many products that are largely consumed in Japan, and thus not only encourage home manufacture, but encourage the development of machinery best suited to their own peculiar needs.

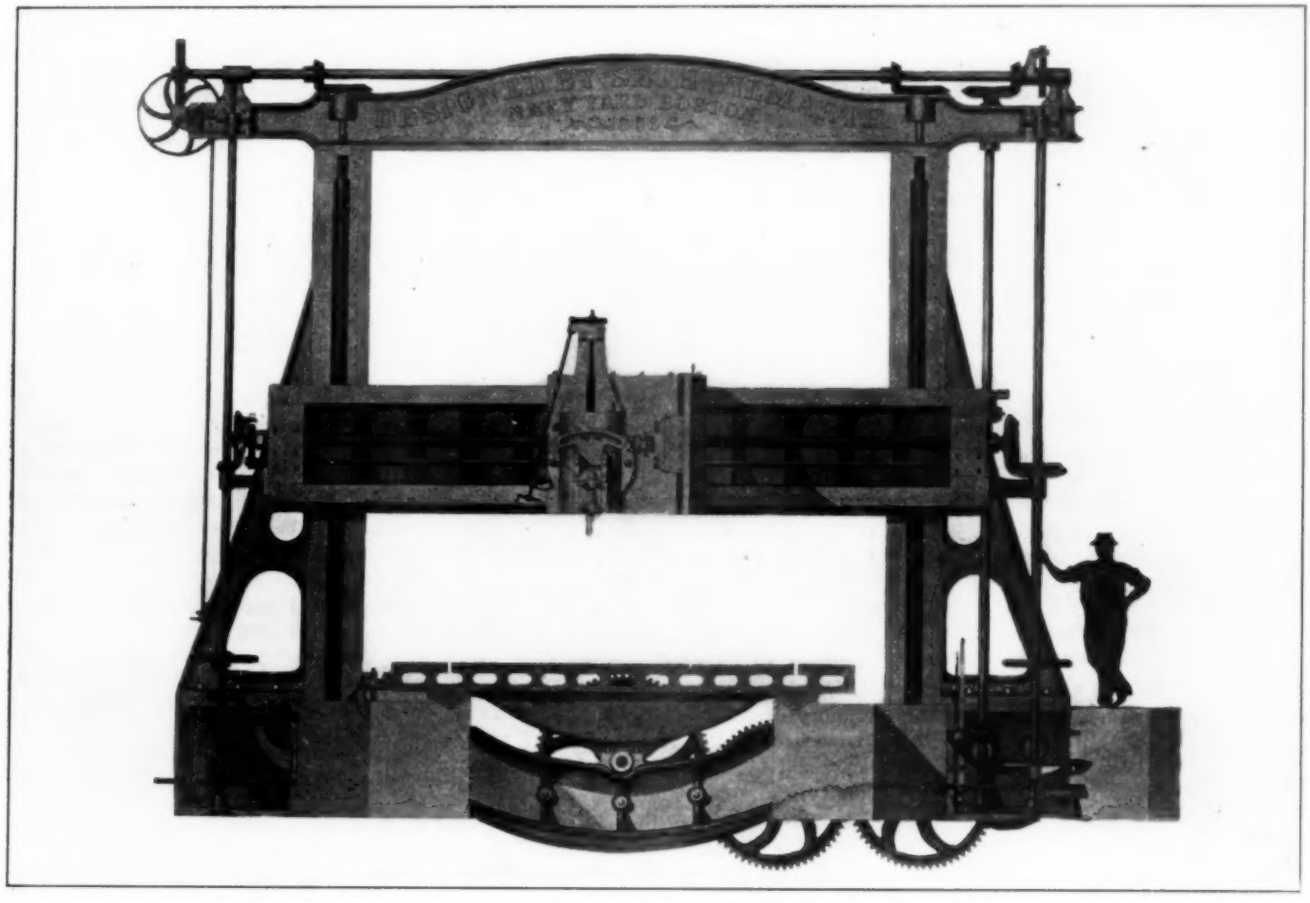


FIG. 2. END VIEW OF SETH WILMARTH PLANER

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

JOHN A. HILL, Pres. and Treas. ROBERT MCKEAN, Sec'y.

505 Pearl Street, New York.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Subscribers can have address changed at will. Give old and new addresses.

Subscription price $4 per year, postage prepaid, to any post office in United States, United States possessions and Mexico. $5.50 to Canada. $7 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

Hill Publishing Co., Ltd., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Business Telegraph Code.

CIRCULATION STATEMENT

During 1908 *we printed and circulated* 1,205,750 *copies of the* AMERICAN MACHINIST.

Our circulation for December, 1908, *was (weekly, monthly and European)* 108,250.

January 7..... 34,750

This paper reaches 34,750 *separate readers each month and* 18,750 *each week.*

None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

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Class Room Instruction for Apprentices by Public School Teachers

Among the plans for industrial education which are receiving much discussion, and which, to the professional educators who have interested themselves in the industrial educational movement is especially attractive, is the half-time system, in which the boys devote alternate weeks to work at their trades in commercial shops and work at their books in the public schools.

The possibilities of this plan are large, but its immediate usefulness is seriously curtailed by the absence of teachers in the public schools who can do what it is proposed to do; namely, coördinate the class-room work with the work in the shop.

The faith of the average educator in his capacity to do this is really touching, and while, by this plan, combined with systematic trade teaching in the shops, the attention of boys may be obtained and something accomplished, it is, we believe, idle to expect from the present generation of teachers any real teaching that will be of much direct use to the boys as workmen.

What is the probability, for example, that the existing race of teachers will be able to give the boys any effective instruction in machine-shop arithmetic or in foundry chemistry? The ordinary school textbook on arithmetic with which we are all acquainted, needs little more than a study and some books of reference for its preparation, and the same is almost, if not quite, true of the standard textbooks on chemistry. The preparation of a book on machine-shop arithmetic, on the contrary, involves first of all a knowledge of shop work, and of actual shop problems which need solution and, similarly, the preparation of a book on foundry chemistry involves first of all a knowledge of the foundry, of its problems, and of what chemistry is doing to solve those problems under the conditions that arise in daily work.

It is as plain as anything can be that the preparation of such books, of which the two named are given only as examples, is entirely beyond the capacity of the existing race of textbook writers. On the other hand, is it possible for any teacher, with no equipment and no knowledge of factory work other than that to be obtained from such books, to teach their subjects with anything like effectiveness? Such an attempt would soon turn the whole attempt to ridicule. There is, we believe, a real danger, under the demand that seems certain to arise, hack textbook writers will rush in and prepare half-baked books which, under attractive titles, will be accepted by those who know even less of the work than their authors and will thus find use which they do not deserve.

These citations illustrate and explain our very languid faith in industrial education as a part of the public-school system for a generation to come. In this, moreover, we do not need to theorize as we have before us an example of nearly complete failure of effective teaching by teachers whose knowledge of a subject is obtained from without, and not from within through personal contact with the work. We refer to the prevailing teaching of the subject of mechanical drawing, which has become so much of a fad, and to which so much time is given to very little purpose.

Those who are acquainted with the teaching of mechanical drawing in the schools understand perfectly well that in most cases it consists of little more than picture-making, and that the useful knowledge obtained by the pupils is of the most scanty kind, due to the fact that the teachers have no inside knowledge of the work and of its requirements.

This experience is a perfect illustration of what may be expected, the teachers' shortcomings in the matter of drawing being exactly analogous to what may be looked for in other subjects. To teach machine drawing as it should be taught one must know the needs and requirements of the shop and these are not to be learned by word of mouth. Underlying numberless practices in the trades is a philosophy which, while it may need only homely words for its expression, is nevertheless outside the understanding of those who have not acquired it by personal contact with the work, without which personal contact we believe no effective teaching can be done.

Wage Earner's Life Insurance

Some time ago in these columns, on page 172, we reviewed the wage earner's life insurance movement in the State of Massachusetts. At that time the issuing of policies had just been begun by the Whitman Savings Bank. Satisfactory progress has since been made and today this bank has in force some 300 policies for an average amount of about $350 each. On November 2 last the Peoples' Saving Bank of Brockton began to issue policies, thus making two savings bank in the State that have availed themselves of the provisions of the insurance act.

The supporters of the movement are carrying out an active educational campaign, in order to get the wage earners of the State interested in the movement and actively participating in its advantages. The Whitman Savings Bank has established some 25 agencies, among which are included two other savings banks, several large manufacturing establishments, charitable societies, organizations for social service and one labor union. Similarly, the Peoples' Savings Bank has some 20 agencies; a large number of

which are represented by the sales agencies of the W. L. Douglas Shoe Company. The taking out of these agencies shows the widespread interest that the movement is arousing and should argue well for its ultimate success. In some cases small printed slips have been put in employee's pay envelops by the factory management, calling attention to this insurance and stating how and where additional information can be obtained or policies applied for.

It is gratifying to point out this wide-extended interest and the ways in which the movement is being furthered. It possesses such real advantages for the wage earners, that every opportunity should be offered to present the subject to them in such a way that they will fully grasp its meaning, and through its means provide for their own old age, or for their beneficiaries. Other States are interested in the movement, as is attested by the number of letters received by Mr. Hunter, Massachusetts State Actuary, inquiring into the details of the scheme and into the results that have been obtained.

New Publications

THE PROPER DISTRIBUTION OF EXPENSE BURDEN. By A. Hamilton Church. 116 5x7⅝-inch pages; not indexed. The Engineering Magazine, New York City. Price, $1.

The contents of this book appeared originally as a series of article in *The Engineering Magazine*. The continued demand for the numbers in which they appeared has led to a revision of the material, and to its republishing in volume form as an addition to the Works Management Library. The value of the original articles is so well known that but little needs to be said by way of review. The character of the material is entirely distinct from much that has been published in its field. Instead of being purely descriptive and presenting specialized adaptations employed in particular shops, and perhaps adaptable nowhere else, Mr. Church's material deals with the broad principles underlying a proper expense burden distribution. The question of printed forms, cards, and the like, is not touched upon at all, but is left, as it should be, to the accountant who is to install a system to meet his specific needs. There are six chapters. Chapter I, "Interlocking General Characters Charges with Piece Costs," treats of the growth of cost accounting, the extent and complexity of cost finding, an analysis of costs and selling price, and the importance of a properly apportioned expense account. In Chapter II the distributing of expense to individual jobs is discussed; three common methods of fixing the incidence of expense burdens are described, analyzed and shown to present elements of unsuitability. These three methods are: The percentage-on-wages method, the hourly-burden method, and the machine-rate method. A statement is given of the author's successful plan that considers a shop as an assemblage of production centers. The following chapters amplify this approved method, show its application, and set forth the advantages of its use. These chapter headings are: The Scientific Machine Rate and the Supplementary Rate, Classification and Dissection of Shop Charges, Mass Production and the New Machine Rate, Apportionment of Office and Selling Expense.

LATHE DESIGN. By Nicolson and Smith. 402 6x10-inch pages; 255 illustrations; indexed. Longmans, Green & Co., New York City. Price, $6.

The substance of this extensive and elaborate treatise, on the kinematical and dynamical principles governing the construction of metal-turning lathes, has been published in large part in the columns of *The Engineer*, of London. Those articles are so well known, and have been so frequently abstracted and referred to by the technical press, that a detailed review of this work is unnecessary. Three lines of investigation and analysis were followed in preparing its material: First, experiments upon the durability of tool steels; second, researches upon the cutting forces acting upon lathe tools; and third, data and particulars collected from practice. The latter are drawn not only from English sources, but also from American. The research work has been done with great thoroughness, and the conclusions have been deduced with great elaboration. Mathematical expressions in the nature of formulas or equations have been derived for all of the important, and some of the unimportant, elements of lathe mechanism. It should be stated, however, that these are worked out with a spirit of perfect thoroughness, and an attempt to establish consistency for lathes of different sizes and for different classes of work. In analyzing current practice there are some points with which we must differ radically, because of our American viewpoint. The most noticeable of these is the sweeping denunciation of the American inverted V-bed. We quote: "The only valid argument in favor of inverted V's is in our opinion that advanced under (c), namely, *that the operator cannot sit upon them.* It occurs to us, however, to suggest that this might be obviated in the case of flat-top guides by supplying wooden boards armed with Swedish nails inverted, and insisting upon their being kept upon the flat bed." The spirit shown in that paragraph is narrow in the extreme. The universal adoption of the inverted V's by American builders is sufficient proof of their utility for the purpose intended. Taking the work all in all, American engine-lathe builders will be surprised at, and should be congratulated for, the excellence of their products in view of their lack of a detailed elaborate analysis of engine-lathe design, such as is here presented by Doctor Nicolson and Mr. Smith.

Henry Wallace Caldwell

Henry Wallace Caldwell, president of H. W. Caldwell & Son Company, of Chicago, Illinois, died December 22 at Redlands, California.

Mr. Caldwell had been an invalid for a number of years and had taken up his residence in California in the hope of improving his health. He was born in Bath county, Kentucky, in 1843, and left college to enlist during the Civil War. Although at the time very young, he attained the rank of lieutenant in Company B, Tenth Kentucky Cavalry and saw service in Kentucky and Tennessee. At the close of the war he moved to Indianapolis, Indiana, and engaged in business there. He was for a number of years general superintendent of the Indiana State Board of Agriculture and in this capacity had charge of the erection of the exposition buildings at the State fair grounds, these being among the first buildings of that class that were erected in the United States.

He afterward engaged in the grain-elevator business and became interested in the mechanical devices used in such plants. His particular attention was directed to the transportation of grain by means of conveyers and he turned his efforts especially to the improvement of the screw or spiral conveyer, which was then a very crude device and ordinarily manufactured by hand by millwrights.

Mr. Caldwell patented and commenced the manufacture of the Caldwell conveyer and for 33 years his name has been associated with the manufacture of this special type of apparatus. While continuing the manufacture and sale of the screw conveyer, he also engaged in the building of grain elevators, moving from Indianapolis to St. Louis in 1876. After several years the grain-elevator contracting department was discontinued and Mr. Caldwell gave his entire attention to the manufacture of screw conveyers and other machinery for the conveying and elevating of materials and the transmission of power.

In 1881 he moved to Chicago and the history of the business has been one of steady growth ever since. In 1892 the business was incorporated and his sons, Frank C. and Oliver N. Caldwell became associated with him.

Mr. Caldwell was married in 1865 to Hannah A. North, whose death occurred eight years ago. In addition to the two sons mentioned, he is survived by his daughters Julia C. Caldwell and Mrs. Dwight M. Swobe, who reside in California.

Mr. Caldwell's long-continued connection with the manufacture of various kinds of machinery and the large proportions to which the business has grown, made him one of the prominent figures in the machinery world.

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make it Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

A Heavy Axle Lathe with onstant Speed Drive

The general appearance of this lathe is clearly shown in Fig. 1, the geared head being at the extreme left of the bed, the axle driving head in the center, one tailstock having a fixed spindle while the other is adjustable and the two carriages, each having an auxiliary bearing on a third way cast on the bed directly beneath the aprons and supporting it against any thrust due to the rack pinion or other strain.

The gear box and method of driving the head is seen in Fig. 2, the drive being from a constant-speed pulley or motor and the feed gearing being directly connected with the main drive, as shown. The bed is of extremely heavy construction, with cross girths forming a box section, and in addition having a web through the center. The ends of the bed are cut away to facilitate the removal of the tailstocks, and in addition to the front and rear V, there is an inner flat track and a 45-degree bevel for an extra carriage bearing.

The drive is through all-steel gears running in oil, and the main driving gear in

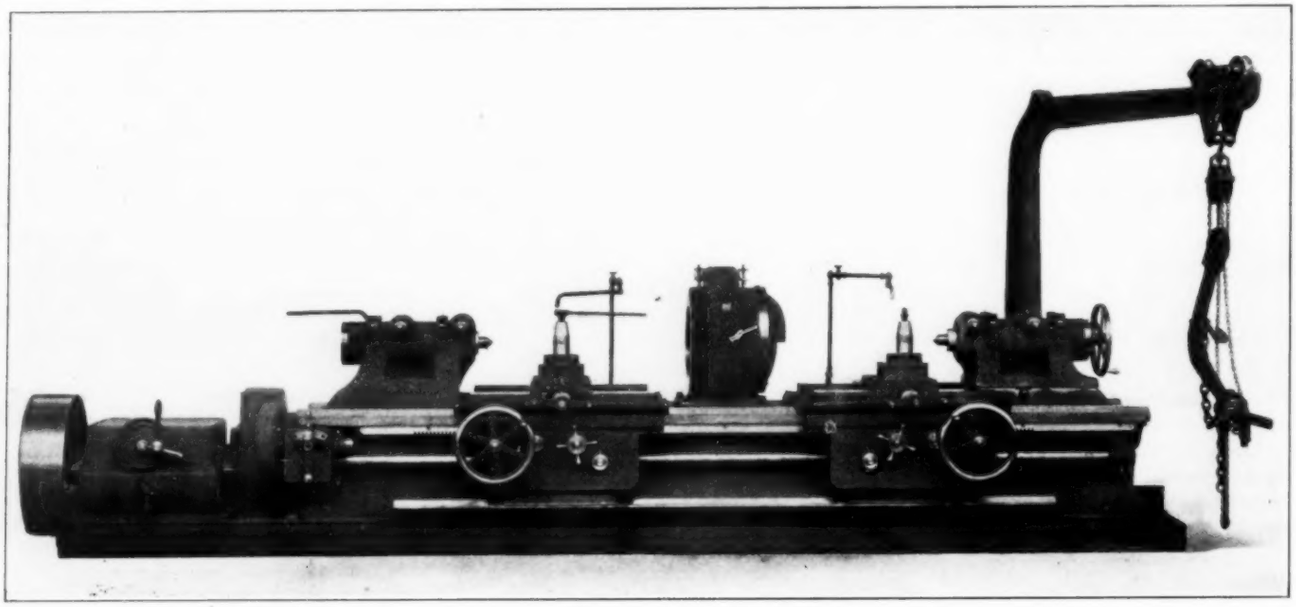


FIG. 1. HEAVY CONSTANT-SPEED DRIVING-AXLE LATHE

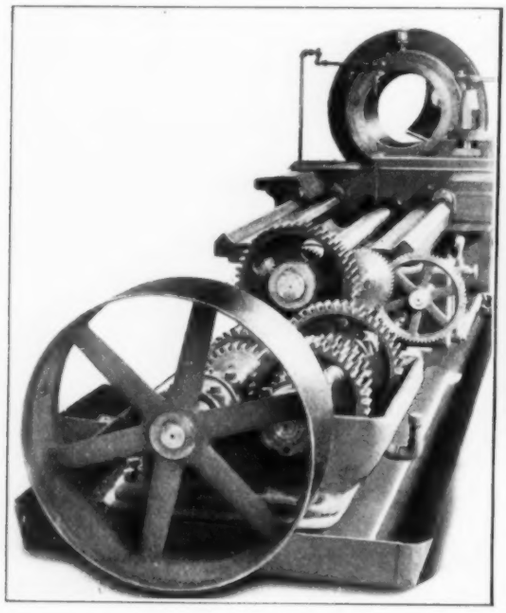


FIG. 2. DRIVING GEARS EXPOSED

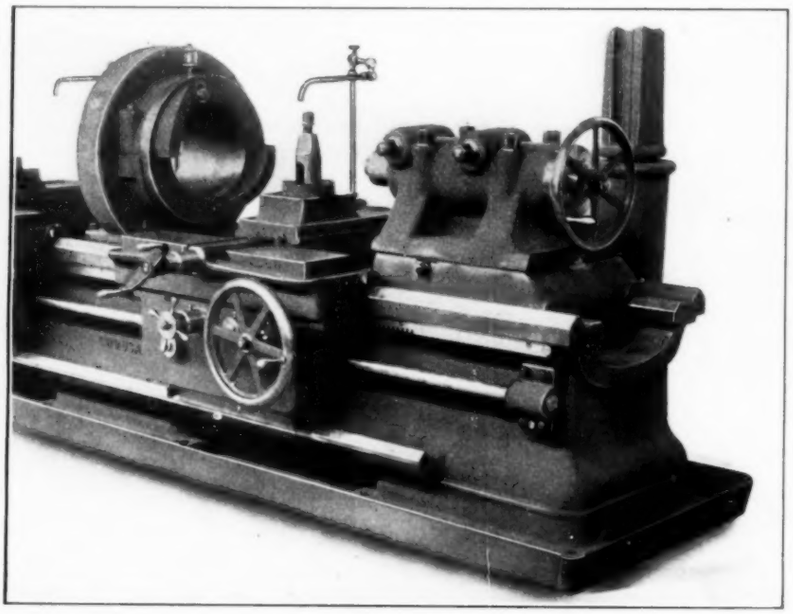


FIG. 3. TAILSTOCK AND CARRIAGE

the center head has a double bearing as has the pinion which drives it. The work is driven by a heavy compensating driver secured to the gear in the center head and having steel base projections for engaging the dogs fastened to the axle.

Fig. 4 gives a good idea of the solid construction of the carriage, which is of the double-wall type so that all gearing is supported at each end of its shaft. The speed of the splined feed rod is controlled by a change-gear box so as to give three feeds, which may be changed without stopping the lathe. The support of the carriage by so many bearing surfaces is the result of experience with this class of work for, in addition to the heavy stress due to the turning tool, many axle bearings are finished by a heavy steel roll or burnisher which compresses the surface of the bearings, and at the same time imposes a very heavy strain on the carriage.

The tailstock is of exceptionally heavy design, and is rigidly clamped to the bed

FIG. 4. DETAILS OF CARRIAGE APRON

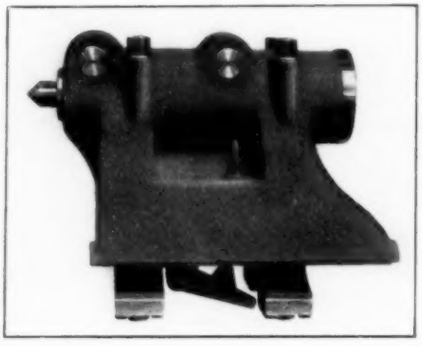


FIG. 5. CONSTRUCTION OF TAILSTOCK

by the four through bolts working directly on the heavy strap beneath. In addition to this, the pawl or dog shown between the strap, engages in a rack which is cast in the bed and tends to relieve the clamping bolt of the excessive end thrust. Two heavy clamps are used for binding the tail spindles.

Provision is made for delivering an ample supply of lubricants to the cutting tools and all journals are equipped with ring oilers. The machine is built by the Lodge & Shipley Machine Tool Company, Cincinnati, Ohio.

A New Testing Machine

The testing machine shown in the accompanying illustration is designed for the "cold bend" testing of iron and steel specimens, which is being specified by many manufacturers for iron and steel.

Instead of the time taken by the bending tools in a regular testing machine, this requires only three minutes to bend a

MACHINE FOR BENDING TEST

specimen double, that is, 180 degrees around a pin, which is of great advantage to a steel mill or other establishment, where many tests must be made in a short time.

The machine is intended for making a "cold bend" test on iron or steel specimens up to a size of one inch square or its equivalent. The specimen is bent around a pin of a diameter equal to its own thickness. Any size of pin up to two inches in diameter may be used, the smaller sizes being reinforced to withstand the bending pressure. The pins have taper shanks so that they can readily be changed to suit the different sizes of specimens. In order to insure ready release from the taper fit, a knockout pin is provided, which, when tapped with a hammer, releases the bending pin. Provision is made for placing the bending pin at varying distances from the center as required. A taper liner at the back of the specimen serves for the adjustment of the various sizes of specimens to be tested. The outer circular edge of the machine is graduated for every five degrees so that the specimen may be bent to any desired angle up to a complete bend of 180 degrees.

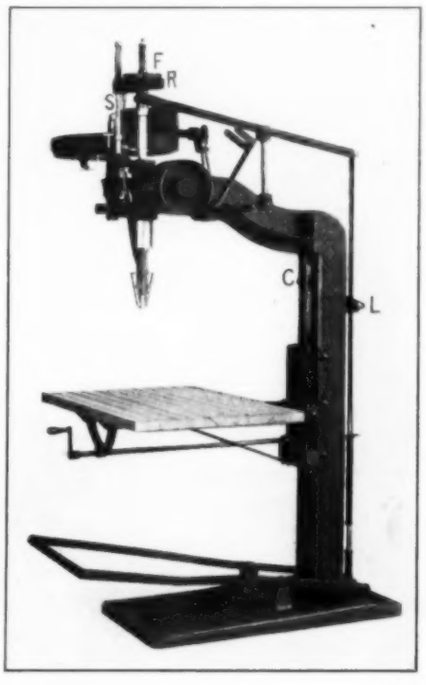
A small Westinghouse reversible, electric motor is mounted on a bracket at the rear of the outfit so that the entire unit may be located wherever desired to give the greatest convenience of access.

The machine is manufactured by Tinius Olsen & Co., of Philadelphia.

Large Screw-driving Machine

This is the latest addition to the line of screwdriving machinery made by the Reynolds Machine Company, Rock Island, Ill., and illustrated in previous issues. This will drive screws to the center of a 48-inch circle, and has 30 inches of vertical adjustment.

The table is raised to automatically clamp the work together as the screw starts, by the cam *C*, which is operated by the treadle, through lever *L*, a spring allowing the table to yield for an unusually thick piece of wood. This also has a positive stop for the spindle so that screws may be driven to any depth desired, and all will be uniform, projecting heads being



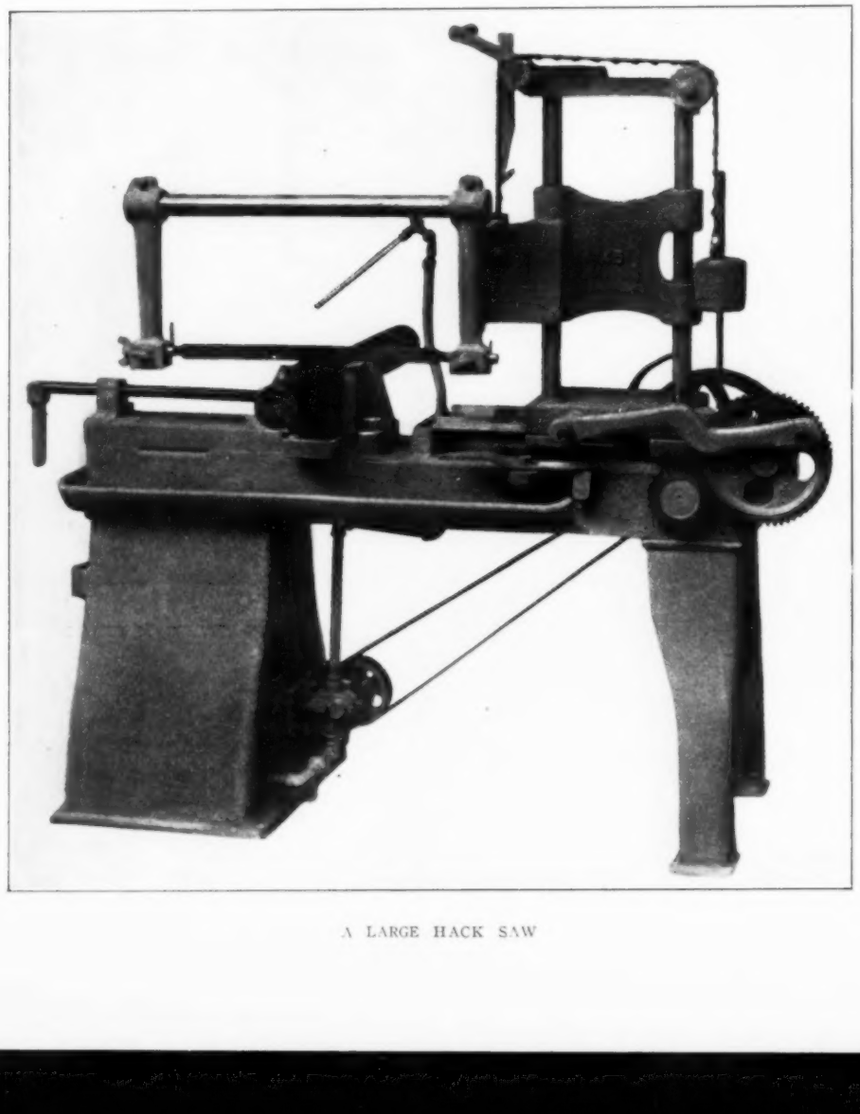
LARGE SCREW-DRIVING MACHINE

easily obtained when wanted. This is done by the flange *F* being extended to form a cone clutch on its edge. The other part of the clutch is a ring *R*, on the spindle and arranged to slide freely on the rod *S*. This is carried upward by the arm operating the escapement cams and follows it downward until stopped by collar *T* throwing out the clutch driving the screwdriver.

A Large Hack Saw

This construction differs from the smaller hack saw by having a sliding head which carries the saw in vertical lines. The whole upright is driven by the geared connection shown. The feed is by gravity, the saw frame being counterweighted, as indicated. Blades can be put into the machine with rake of teeth either forward or backward. After using one-half of the blade, by reversing the saw in the frame the other half can be used and with equally as good results.

The machines are equipped with a pump for lubricant, the reservoir being in the leg and have an automatic knockoff when the saw is through the cut. They are made by the Diamond Saw and Stamping Works, Buffalo, N. Y.



A LARGE HACK SAW

Shaving and Thread Rolling Tools for the Automatic Screw Machine

The illustrations represent two interesting tools made by the National Acme Manufacturing Company, Cleveland, Ohio, for use on its automatic screw machine. Fig. 1 shows a shaving tool and a thread-rolling device on the top slides of the machine, and Fig. 2 shows more clearly the threading roller and the work before and after threading. The shaving tool consists of a holder carrying a rest and a cutting blade. The holder is pivoted to allow the rest and cutter to find their own center. As the distance between shaving tool and rest is positive when the tool is once set, and as the pivotal action permits the device to find its own center, the work produced is of exceptional accuracy and degree of finish. The method of adjusting the tool will be understood fully upon inspection of the engraving.

The threading device consists of a threading roll carried by a holder attached to the top slide. The tool is especially adapted to rolling threads at the rear of a shoulder, although, of course, it may also be run on the end of a piece where a die would ordinarily be used. Fig. 2 shows a typical piece of work requiring a thread at the inner side of a shoulder where this thread roller is readily operated between the body of the piece and the end of the chuck.

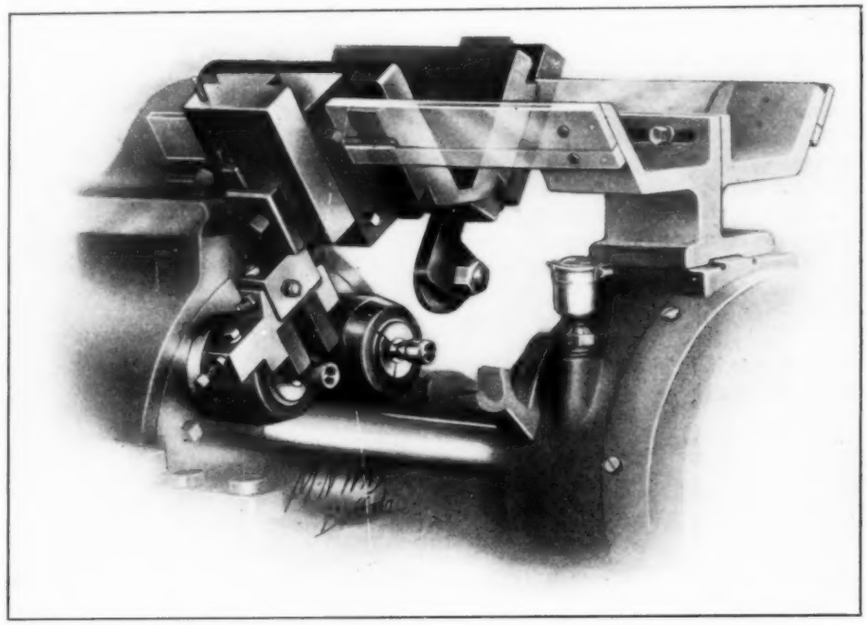


FIG. 1. SHAVING AND THREAD-ROLLING TOOLS IN THE ACME AUTOMATIC SCREW MACHINE

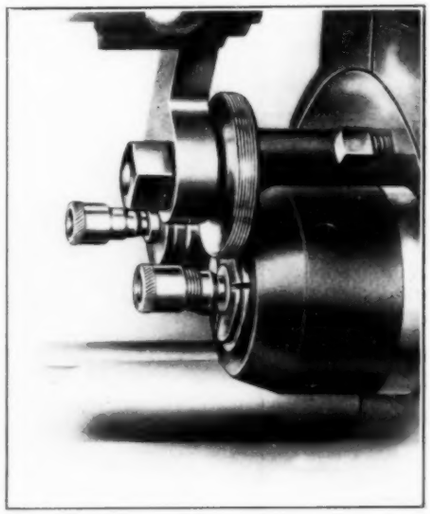


FIG. 2. THE THREAD ROLLER AND THE WORK BEFORE AND AFTER THREADING

A Shaft Turning Lathe

This may be called a special form of engine lathe for increasing the output on plain turning or threading work, and on certain work will it is claimed, do the work of five or six regular lathes. It is practically a regular 16-inch Prentice lathe with its geared head, but fitted into a special carriage and tailstock, and has a feed rod and lead screw for threaded work.

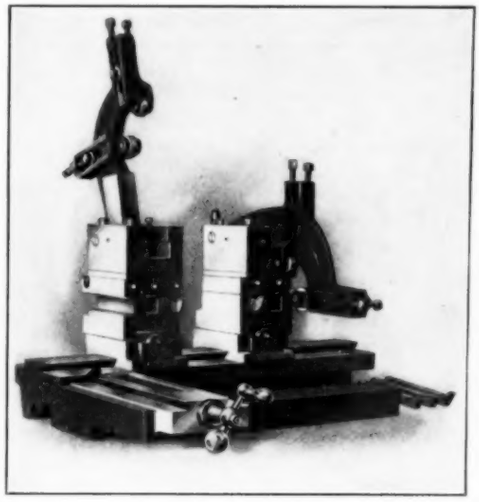


FIG. 1. FRONT VIEW OF SPECIAL CARRIAGE

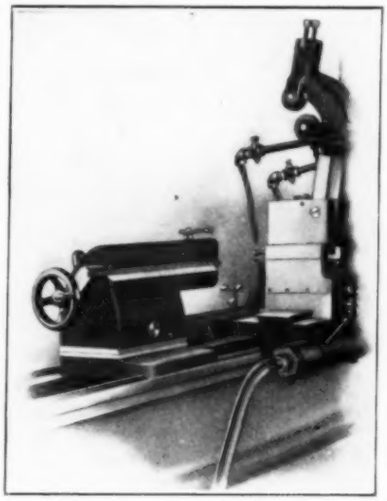


FIG. 2. BACK SIDE OF TAILSTOCK

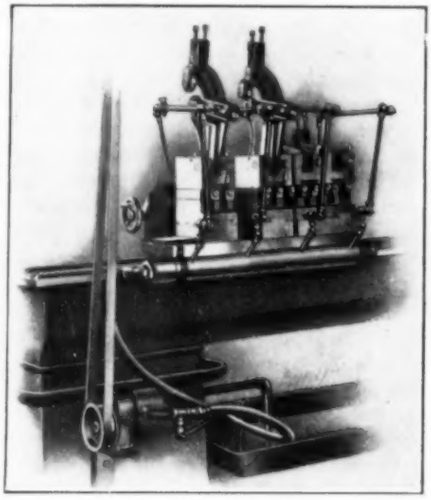


FIG. 3. CARRIAGE PASSING TAILSTOCK

The new carriage is shown in Fig. 1, equipped with two tool blocks which, it will be seen, are at the back, leaving the front perfectly clear except as the roller rests are brought down as shown at the right. The tools are held rigidly by hardened-steel taper wedges as shown, in slides that are adjustable for diameter, and above them are the roller rests, pinned at the back and having the long side bearing to insure steadiness. These are also adjustable, independent of the tools. This roller rest, after being lowered into position, is forced under the ledge at the right, which makes it very rigid and also insures its being brought into the right position every time, as even the smallest chip will prevent its being locked in place. The rolls may be fastened at either side so as to always follow the cut directly, this combination of tools and rollers making what is practically a heavy box tool.

Another tool block fits on the cross slide at the left, but is removed to show the back tools more clearly. This brings the carriage bridge at the left instead of the center, which enables almost the whole carriage to be run by the tailstock. The various tool blocks are clamped rigidly by the packing screws, after being set to the desired positions, and are practically solid with the carriage.

Fig. 3 shows the back side of the tailstock, in which the spindle has been cut away at the back to allow the tools to pass clear by the tailstock. The handwheel has also been moved down out of the center for this purpose. After setting the tools for the different shoulders, the carriage is run behind the tailstock so that the leading tool can take the first cut. The cut in the tailstock allows tools set to turn diameters as small as 13/16 inch to pass by it.

Fig. 4 gives an idea of the use of four tool blocks and shows how the lubricant is forced to each tool independently of the others.

Samples of work done on this lathe, plain turning, having numerous diameters, shoulders and collars, show remarkably quick time in hundred lots, which is, of course, the only way to get an idea of what a machine can really do. Some of

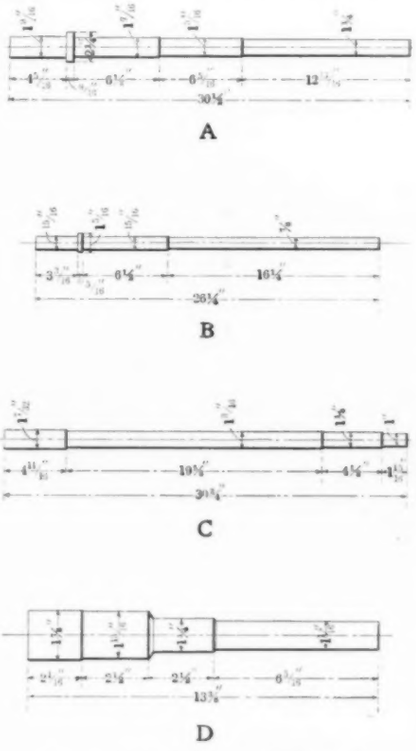


FIG. 4. SOME OF THE WORK DONE

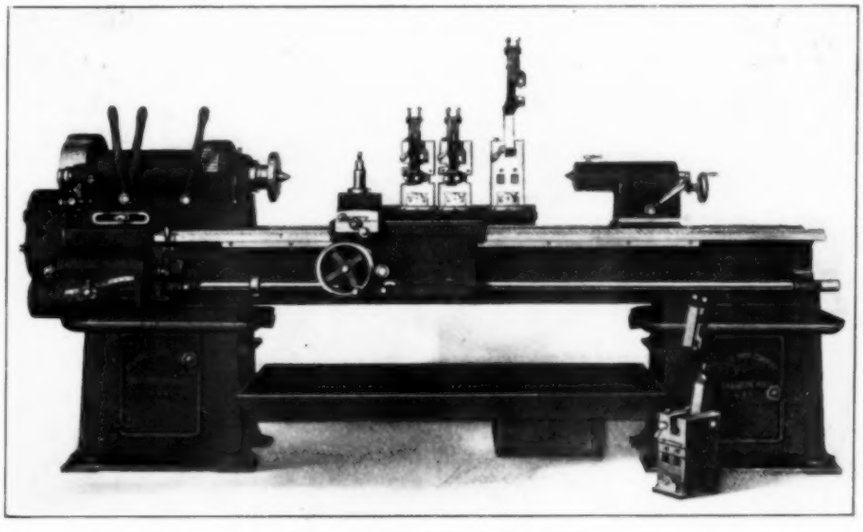


FIG. 5. SHAFT TURNING LATHE

these are shown in Fig. 5; A, averaging 13 minutes; B, 11 minutes; C, 12½ minutes, and D, 4 minutes, all in lots of 100 pieces.

The lathe is made by the Prentice Brothers Company, Worcester, Mass.

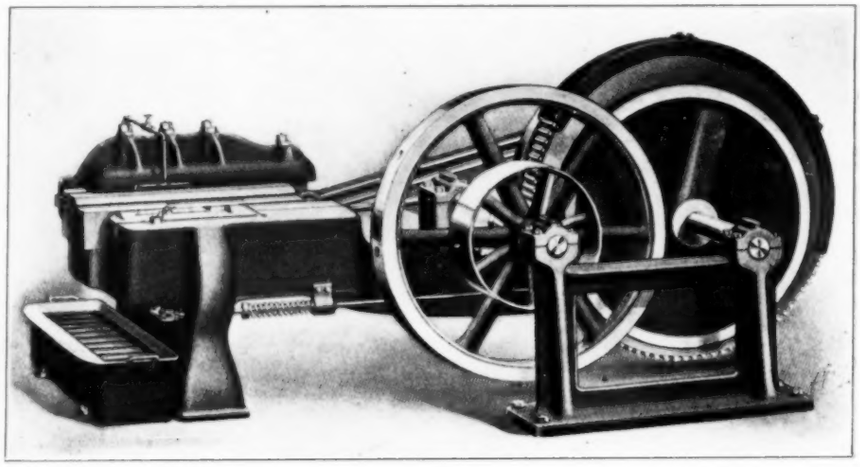
An Automatic Vise

This differs from the usual rapid-adjusting vise in that the quick-acting feature is not for saving time in moving the jaws for a considerable distance, but for clamping the work automatically without touching the vise screw. The vise is adjusted in the regular way for the first piece of work, and after this is finished, a pressure on the treadle releases the piece. The workman then puts in another piece of work, releases the treadle, and the work is clamped as firmly as before.

This is accomplished by the construction shown in Figs. 2 and 3. In these the movable jaw and bar are removed, showing the heavy spring around the screw, the nut *A* and the wedges *B* and *C*. The spring bears between the end of the vise body and the square stop nut at the right. When the treadle is pulled down, block *B* moves down out of the way and *C* forces the nut *A* so as to open the jaws enough to remove the work, compressing the spring as it does so. When the new piece of work is put in and the treadle released, *C* goes up and allows *A* to be drawn back by the spring, while *B* locks it in place, thus enabling it to handle duplicate pieces very quickly. It is substantially made, with a swivel or plain base, by the Quick Automatic Vise Company, 236 Mill street, Rochester, N. Y.

A Heavy Thread Rolling Machine

This has been designed for handling bolts up to 1 inch in diameter which require a machine of the heavy construction shown, being geared, and having a flywheel to insure its steady running. Wearing surfaces are made of large proportions to aid in maintaining accurate alinement of dies, the die slide being unusually long and backed by a bank of hardened rollers. The crank has a Whitworth quick return, which increases the output but still allows ample time for feeding. It runs 35 strokes a minute and weighs 18,000 pounds, being built by the National Machinery Company, Tiffin, Ohio.



A HEAVY THREAD ROLLING MACHINE

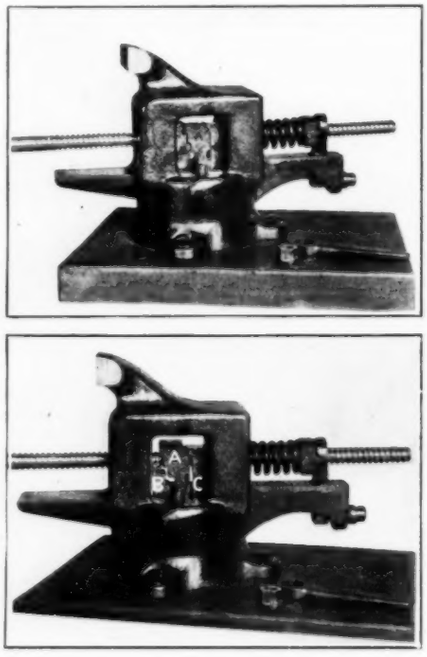
A New Coining Press

While this has the same general appearance as most coining presses there are several features in the design which are new. The toggle mechanism is below instead of above the dies, and the ejector rod, fastened to the bed by the ball joint at the bottom, works through the table and ejects the coin as the ram descends.

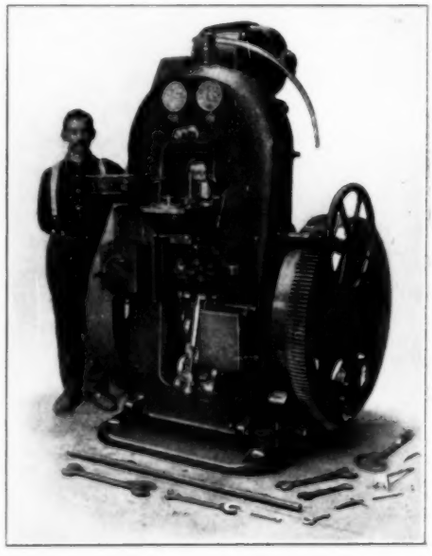
The upper die is held in a swinging head which can be unlocked by the lever at the left and swung up at right angles by the lever at the right. This allows frequent inspection of the upper die without loss of time in removing or adjusting. The lower die can also be removed easily and quickly.

Instead of inserting a bar in the holes in the flywheel to move it around for hand adjustment, gear teeth are cut in the balance wheel and the pinion on the hand

FIG. 1. PUTTING IN A NEW PIECE OF WORK



FIGS. 2 AND 3. DETAILS OF THE AUTOMATIC VISE



A NEW COINING PRESS

wheel, which can be slipped into mesh when desired, allows easy and accurate adjustment. The press has a die adjustment by means of a heavy wedge, shown just above the swinging head. The upper die head is supported by a stiff spring which can be adjusted to just take the weight of the head in setting the dies, or to hold the head firmly in place.

A new feeding mechanism has been introduced which, while extremely simple, prevents the possibility of two blanks getting between the dies at once and also positively removes the coins until the last one is reached; this remaining between the dies to protect them.

An interesting fact in this connection is the time required for the metal to flow into all portions of the die. A press coining silver dollars must run slower than one for dimes, as more metal is being operated on. This press can be run from 90 to 120 revolutions per minute by the motor shown, and exerts a pressure of 250 tons. It is next to the largest coining press built by the Ferracute Machine Company, Bridgeton, N. J., and was recently shipped to a foreign mint.

Personal*

A. W. Watkins joined the Manning, Maxwell & Moore forces on the first of the year and will represent his company in the New York district.

Nino Fabris, engineer of the Rome branch of Alfred H. Schütte after a short stay in this country, during which he married an American girl, sailed for home January 5.

F. A. Seeger, for the past four years superintendent of the Southern Well Works Company, Chattanooga, Tenn., has resigned his position, and expects to return to southeast Texas.

Arthur L. Stevens, well known as an industrial and furnace engineer, has become actively associated with the Rockwell Furnace Company, New York City, since January 1. Mr. Stevens will devote his time to following up the work of his company in placing in the market a complete line of furnaces for industrial purposes.

Obituary

Samuel A. Johnson, for a long time connected with the Baldwin Locomotive Works, and father of Alba Johnson, of that company, died December 29. Mr. Johnson was born in Maine 84 years ago and became associated with the Baldwin Locomotive Works in the seventies, where he remained for 25 years.

Achille L. Archambault, engineer and inventor, and founder of the Kensington Engine Company, of Philadelphia, died at his home in that city December 28, aged 87 years. Early in life Mr. Archambault displayed mechanical ability and brought out several inventions of much importance. In a small machine shop he built the first small portable engines, and their success formed the foundation of the Kensington Engine Company. Mr. Archambault bears the distinction of having built the first steam yacht in American waters, and was the recipient of a medal from the Franklin Institute in honor of his inventions.

*Items for this column are solicited.

Business Items

Schuchardt & Schutte, New York City, Ernst Müller, manager, has moved its store from 141 Cedar street to 90 West street.

Posters have been placed at the Westinghouse air brake plant in Wilmerding, near Pittsburg, announcing that with the beginning of the new year the men will resume work in full. The notice applies to the employees of both shops and the foundry, where some of the men have been employed on short turns.

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E. G. Smith Co., Columbia, Pa.

Test indicators. H. A. Lowe, Cleveland, O.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Draftsmen: put in a requisition for my parallel device; $2.50. F. G. Hobart, Beloit, Wis.

Light fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Machinery built to order; up-to-date plant. Write Brunswick Refrigerating Co., New Brunswick, N. J.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Machines designed; automatic, special. Practical working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

For rent, in best part of Manhattan, first-class general construction and machine shop, also large storage room. Apply on premises, S. Healey Co., 650 West 51st St., New York.

Lathe and machine work of every description, patterns, gear cutting, screw machine work, iron, brass and aluminum castings. The Sipp Electric and Machine Co., Paterson, N. J.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MACH.

A first-class mechanical engineer wants parties to take up the manufacture of gasolene traction engines. Will furnish plans alone, or plans and services to build and dispose of product. Box 811, AMER. MACH.

New patent laws. A firm of high-class machine toolmakers with modern plant (including foundry) are prepared to undertake the manufacture of suitable patented specialties on behalf of foreign patentees who are desirous of complying with the new patent laws. Roberts Bros., Dukinfield, Manchester, England.

The annual meeting of the stockholders of the Hill Publishing Company, for the election of directors for the ensuing year and for the transaction of such other business as may properly come before the meeting, will be held at the office of the company, in the Hallenbeck building, 497-505 Pearl street, Borough of Manhattan, New York City, N. Y., on Tuesday, January 26, 1909, at 12 o'clock noon.

Dated, New York City, December 19th, 1908. Robert McKean, Secretary.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

I wish to correspond with any company desiring the services of a progressive and up-to-date manufacturing superintendent. Box 813, AMERICAN MACHINIST.

Screw machine foreman; hand or automatic; wide experience, all machines; Brown & Sharpe and National-Acme automatic expert; systematizer; cost reducer. "Auto.," AMERICAN MACHINIST.

Practical mechanic with 15 years' experience as superintendent on small and medium duplicate manufacturing, desires position handling 50 to 100 men; can design special tools for cheap and rapid production; hustler and originator, salary moderate. Address Box 814, AMERICAN MACHINIST.

ILLINOIS

Superintendent; mechanical expert; duplicate machinery preferred; 25 years' experience; reference gilt edge. Box 805, AM. M

Tool room foreman desires change; first class on tools for adding machines, cash registers and typewriters. Box 764, AM. MACH.

IOWA

Superintendent or general foreman, 17 years' machine shop experience, 8 years' drafting; expert in steam and electric hoisting engines and general machine work; can handle men to advantage and produce results. Box 809, AMERICAN MACHINIST.

MASSACHUSETTS

Wanted—Position as manager or manager's assistant in machine shop; thirteen years' experience. Can bring a very desirable manufacturing business. Box 778, AMER. MACH.

NEW JERSEY

An inventive, thorough, broadly experienced mechanic, practical toolmaker; an organizer, proven ability, wants change; responsible position. Reliable firms only. "Ability," AMERICAN MACHINIST.

Young man, machinist-toolmaker, steady, first-class references, desires position as outside repairman for first-class typewriter company; New York or vicinity. Address "Typewriter," AMERICAN MACHINIST.

Wanted—Position as superintendent by one who has worked up from the bench; having had 20 years' experience along the line of type-casting machines, typewriters, electrical instruments and tools for interchangeable work; open for engagement Feb. 1, 1909. Address "Ambitious." AMERICAN MACHINIST.

NEW YORK

Expert tool designer, desires change. Ten years' experience on tools, jigs and fixtures. Box 767, AMERICAN MACHINIST.

Patternmaker; typewriter models and fixtures a specialty. Job shop experience. Box 802, AMERICAN MACHINIST.

First-class draftsman, technical education, Corliss or high-speed engines, wants position. Box 816, AMERICAN MACHINIST.

Draftsman, 6 years' experience, general and automatic machinery; also 3 years' practical shop experience. Box 812, AMER. MACHINIST.

Draftsman, mechanical engineer, seven years' experience with large concerns; first-class layout and detailer, wants position. Box 798, AMERICAN MACHINIST.

Automatic machines making and assembling metal and paper parts cheaper. Mechanical engineer, long experience, desires position to design and build same. "Automatic," AM. M.

Designer, age 30; wide experience, special and automatic machinery, experimental design, tools, fixtures; able man; location, New York City. Box 799, AMERICAN MACHINIST.

High-grade designer; 14 years' broad shop and office experience in heavy machine tools, automatic machinery, hydraulics, electric machinery. Technical, original, resourceful, inventive ability to a high degree; successful handler of men. "Superior," AMER. MACH.

Mechanical engineer is open for engagement

as superintendent, master mechanic or general foreman; technical education; large experience as designer and manufacturer of interchangeable machinery, sheet metal goods, electric instruments, typewriters, etc. Box 804, AMERICAN MACHINIST.

OHIO

Thoroughly competent and reliable pattern-maker; 32; desires position with good firm. Box 801, AMERICAN MACHINIST.

Superintendent, chief engineer and designer, twelve years' practical experience, thoroughly versed in best shop practice; executive ability, and an inventor; prefer small company that wants to improve their line; any locality. Box 810, AMER. MACHINIST.

OREGON

Master mechanic, responsible, wide-awake man, extensive and varied experience constructing smelting, power and printing plants, steel works, railroads, rolling, cement and other mills, also manufacturing heavy and light machinery in the States, Canada, South America and Germany; age 40. Box 720, St. Johns, Oregon.

PENNSYLVANIA

A first-class mechanic wants a position as experimenter where skill is required. Box 817, AMERICAN MACHINIST.

Position of responsibility wanted; 13 years' experience in steel foundry and pattern shops; references on demand. Box 806, AMERICAN MACHINIST.

Cost expert, systematizer and chief draftsman; 12 years' experience; will be open for position after March 1; technical graduate. Box 800, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

INDIANA

Wanted—Two inspectors, two grinders, six lathe men, two toolmakers, one foreman, four machinists, all for work on gasolene motors. Good wages. Box 666, AMER. MACHINIST.

Wanted—Two A-1 Jones & Lamson operators as assistants to foreman, to set up machines and keep tools in condition; permanent position at 50c. per hour. If you are not thoroughly capable, do not apply. Maxwell-Briscoe Motor Co., New Castle, Ind.

MARYLAND

Wanted—Draftsman familiar with air compressor and steam-engine work. Address with full particulars, Slaysman & Co., 718 East Pratt St., Baltimore, Md.

MASSACHUSETTS

Wanted—First-class, high-grade mechanical inspector experienced on medium and large work. None but the best need apply. "E. G.," AMERICAN MACHINIST.

Wanted—Mechanical draftsman, accustomed to medium size machine tool work. None other than a first-class man capable of taking charge of a few men need apply. Reply, stating age, experience, etc., to P. O. Box 632, Springfield, Mass.

Wanted—Foreman for tool and repair department; good mechanic with experience in making cutters, hobs and forming tools, and doing repair work on general machinery. State age, experience and wages expected. Box 781, AMERICAN MACHINIST.

Wanted—Man in office of gear cutting shop as general assistant to manager; must have good mechanical judgment, and be quick at figures. One experienced in gear business preferred. State age, experience and salary expected. Box 782, AMERICAN MACHINIST.

Wanted—In Massachusetts, foreman for brass foundry employing about 25 men; must be thoroughly competent on machine bench and floor molding, and understand all branches of brass foundry work, especially in light brass and composition castings both plain and ornamental, much of which is similar to chandelier and ornamental lamp and cash register work. Castings must be sharp and clean and present nice, rich yellow and red brass color when dipped and polished. Give detail experience; references; your idea of operating foundry and salary expected. Box 803, AMERICAN MACHINIST.

MICHIGAN

Foreman wanted by machine shop making high-class machinery, employing about 50 men; must be capable and experienced, able to handle men to advantage; state experience, age and wages expected. Address Box 797, AMERICAN MACHINIST.

Wanted—General foreman of machine work by boiler and radiator company. Man will be in charge over department foremen and must have good executive ability; must be a first-class mechanic and must be able to produce the best possible results. Give age, experience and references. Box 779, AM. MACH.

NEW JERSEY

Wanted—Draftsman on special machinery; must have shop and drawing room experience. Man with executive ability preferred. State age, experience and give reference and salary. Box 788, AMERICAN MACHINIST.

Experienced lathe hand on light and heavy work, accustomed to piece work or premium system, for a working lathe "Boss" to be responsible for the work of eight or ten lathe hands. $3.50 for 9-hour day, and steady work for the right man. Box 808, AMER. MACH.

NEW YORK

Wanted—Detail draftsman who is quick, neat and reliable on making drawings from existing medium size machines. State detail experience, age, wages and where employed Niagara Machine and Tool Works, Buffalo, N. Y.

OHIO

Toolmaker; one competent to make tools for rolling and drawing sheet metal. Box 791, AMERICAN MACHINIST.

Wanted—Designer and draftsman experienced on sheet-metal working machinery and automatic feeds for same; state experience and salary expected. Box 815, AM. MACH.

WISCONSIN

Shop superintendent wanted in the manufacture of lubricating specialties. Must have ability to get up new designs. State experience and salary expected. Box 762, AM. M.

FOREIGN

Wanted—Capable engineer, with technical education and mill experience for good and permanent situation at rolling mill in the middle of Sweden. Apply, stating full particulars of age, education, experience, salary wanted, and inclosing copies of testimonials to "Rolling Mill Engineer," care of S. Gumealli Annonsbyra, Stockholm, Sweden.

For Sale

Twenty volumes AMERICAN MACHINIST. Volumes 11 to 31 inclusive. R. M. Clough, Tolland, Conn.

For Sale—One-half interest in machine shop, doing nice business, located in Central, Mich. Partner must be able to take charge of shop. Address Box 807, AMER. MACH.

For Sale—A solid brick, steel construction, factory building, with 7½ acres of land near Chicago. Now unoccupied. Size 110x541. Suitable for iron working business. Has engine, boilers, dynamos, etc. Most favorable prices and terms will be given. Chicago Highlands Association, 1315 Wells Building, Milwaukee, Wis.

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New "Whitney" Quiet Chain

(SCHMIDT PATENT)

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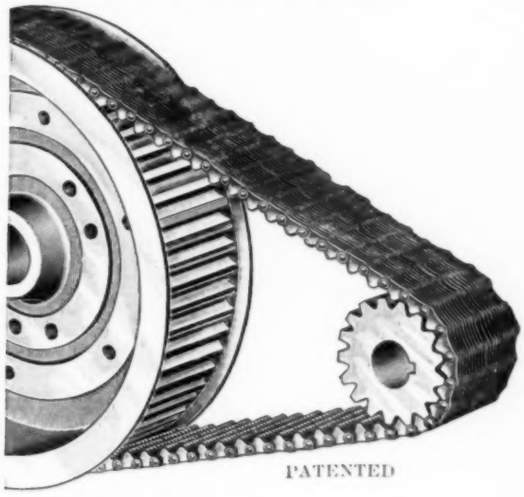
Detachable and Riveted Roller Chains.

All popular sizes.



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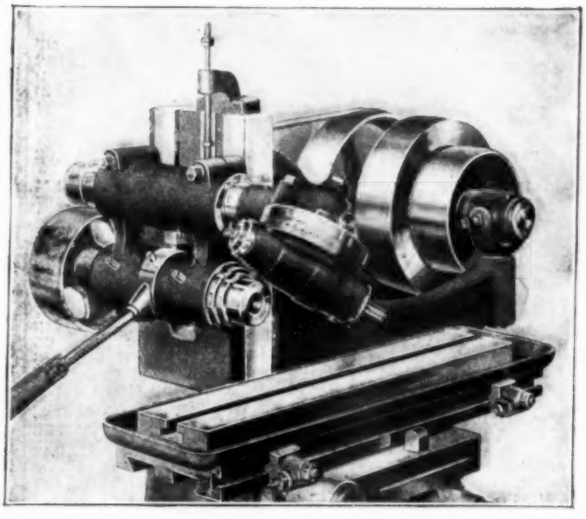
Latest Improved "Whitney" CHAIN BELT is a great success for many purposes.



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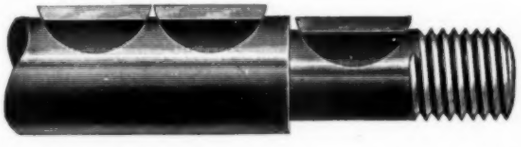

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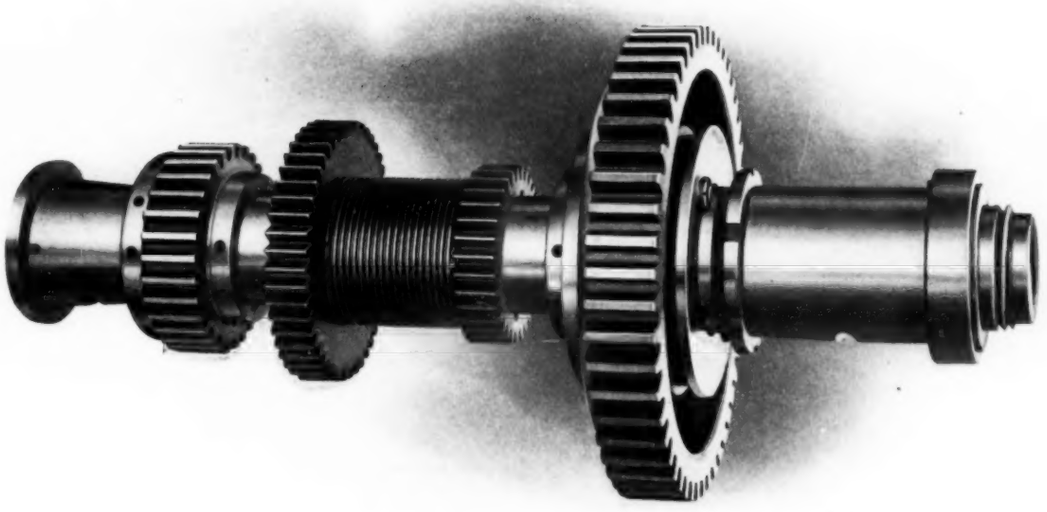

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Universal Fluxine Co., Urbana, O.

Compound, Pipe Joint

Dixon Crucible Co., Joseph, Jersey City, N. J.
Smooth-On Mfg. Co., Jersey City, N. J.

Compressors, Air

Blaisdell Machinery Co., Bradford, Pa.
Bury Compressor Co., Erie, Pa.
Clayton Air Compressor Works, New York.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Spacke Machine Co., F. W., Indianapolis, Ind.

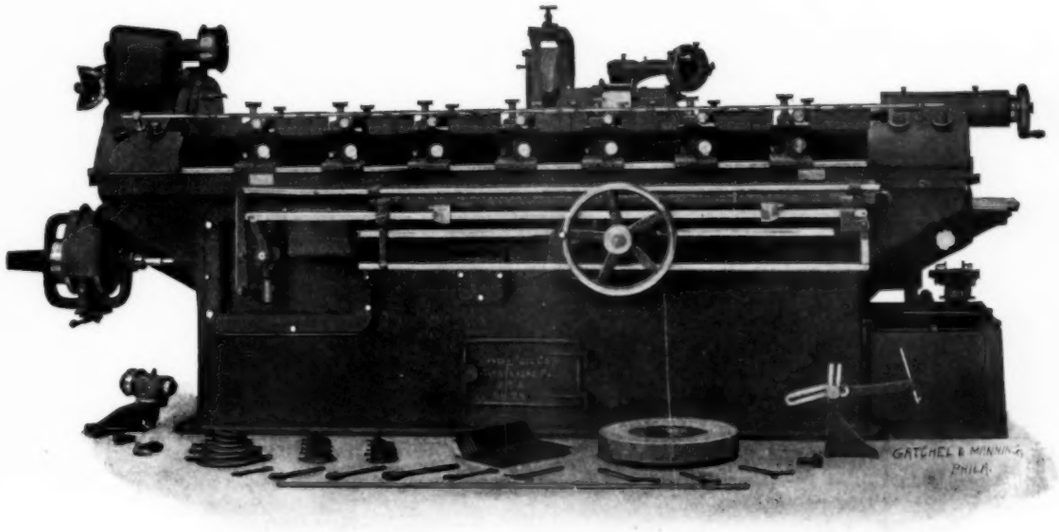
Compressors, Gas

Blaisdell Machinery Co., Bradford, Pa.
Ingersoll-Rand Co., New York.

Cones, Friction

Evans Friction Cone Co., Newton Centre, Mass.

A MANUFACTURING GRINDER



LANDIS 12″ x 96″ PLAIN

It has automatic feed to the grinding wheel, that will size work within .00025″.

It has accurate reversing mechanism.

It has variable speed geared headstock.

It has massive grinding wheel head with back lash device.

Grinding wheels 18 inches in diameter by 1½ and 2½ inch face are regularly furnished.

The guide ways of the grinding wheel carriage and bed, as well as the top of the work table are chilled, thereby increasing durability, and ensuring permanent alignment.

Our descriptive circulars are full of information and can be had for the asking.

Will you do the asking?

Landis Tool Company, Waynesboro, Pa., U. S. A.

AGENTS—Marshall & Huschart Machinery Co., 64 So. Canal St., Chicago, Ill., St. Louis, Mo., Indianapolis, Ind. Walter H. Foster Co., 50 Church St., New York. C. W. Burton, Griffiths & Co., London and Glasgow. Schuchardt & Schutte, Berlin, Vienna, Stockholm, St. Petersburg, Copenhagen and Budapest. Alfred H. Schutte, Cologne, Brussels, Liege, Milan, Paris and Bilbao. A. R. Williams Machinery Co., Toronto. Williams & Wilson, Montreal, Canada.

Connecting Rods and Straps

Electric Welding Products Co., Cleveland, Ohio.
Standard Connecting Rod Co., Beaver Falls, Pa.

Contract Work

Blanchard Machine Co., Cambridge, Mass.
Cell Drier Mach. Co., Taunton, Mass.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Fuller Mfg. Co., New Haven, Conn.
Merritt, Jos., Hartford, Conn.
Morrow Mfg. Co., Elmira, N. Y.
Owen Machine Tool Co., Springfield, O.
Schaeffer Mach. Wks., Phila., Pa.
Turner Mach. Co., Danbury, Conn.

Controllers and Starters, Electric

Crocker-Wheeler Co., Ampere, N. J.
Cushman Electric Co., Concord, N. H.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Conveyors, Automatic

Lamson Consolidated Store Service Co., Boston, Mass.
Link-Belt Co., Philadelphia, Pa.

Coping Machines

Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Corundum

See Grinding Wheels.

Cotters

Cleveland Twist Drill Co., Cleveland, Ohio.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores

Cleveland Twist Drill Co., Cleveland, Ohio.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Counters, Revolution

Root Co., C. J., Bristol, Conn.
Schuchardt & Schutte, New York.
Veeder Mfg. Co., Hartford, Conn.

Countershafts

Almond Mfg. Co., T. R., Ashburnham, Mass.
Builders Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Dill Slotter People, Phila., Pa.
Evans Friction Cone Co., Newton Centre, Mass.
Garvin Mach. Co., New York.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Norton Grinding Co., Worcester, Mass.
Mossberg Wrench Co., Central Falls, R. I.
Safety Emery Wheel Co., Springfield, O.
Smith Countershaft Co., Boston, Mass.

Countershafts, Friction

Dill Slotter People, Phila., Pa.
Evans Friction Cone Co., Newton Centre, Mass.
Wilmarth & Mormon Co., Grand Rapids, Mich.

Counting and Printing Wheels

Franklin Mfg. Co., H. H., Syracuse, N. Y.

Couplers, Hose

Greene, Tweed & Co., New York.
Independent Pneu. Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.

Couplings

Almond Mfg. Co., T. R., Ashburnham, Mass.
Caldwell & Son Co., H. W., Chicago, Ill.
Davis Machine Co., W. P., Rochester, N. Y.
Link-Belt Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Niles-Bement-Pond Co., New York.

Couplings—*Continued.*

Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Williams Fdry. & Mach. Co., Akron, Ohio.

Cranes

Brown Hoisting Mach. Co., Cleveland, O.
Byram & Co., Inc., Detroit, Mich.
Case Mfg. Co., Columbus, O.
Cleveland Crane & Engineering Co., Wickliffe, Ohio.
Manning, Maxwell & Moore, Inc., New York.
Maris Bros., Philadelphia, Pa.
Nicholls, Wm. S., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Crank Pin Turning Machines

Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts

Standard Connecting Rod Co., Beaver Falls, Pa.

Crucibles

Dixon Crucible Co., Joseph, Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Crushers

Farrel Fdry. & Mach. Co., Ansonia, Conn.
Niles-Bement-Pond Co., New York.
Link-Belt Co., Philadelphia, Pa.

Cupolas and Ladles, Foundry

Byram & Co., Inc., Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.

Cups, Grease

Lunkenheimer Co., Cincinnati, O.

Cutters, Milling

Adams Co., Dubuque, Iowa.
Becker Milling Machine Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hardinge Bros., Chicago, Ill.
Harrison & Knight Mfg. Co., Newark, N. J.
Ingersoll Milling Mach. Co., Rockford, Ill.
Kearney & Trecker, Milwaukee, Wis.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno M., Gloucester City, N. J.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Ward & Son, Edgar T., Boston, Mass.
Whitney Mfg. Co., Hartford, Conn.

Cutting-Off Machines

Armstrong Bros. Tool Co., Chicago Ill.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Machine Co., W. P., Rochester, N. Y.
Hurlburt-Rogers Mach. Co., South Sudbury, Mass.
McCabe, J. J., New York.
Newton Mach. Tool Works, Inc., Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Cutting-Off Tools

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.

Cutting-Off Tools—*Continued.*

Cleveland Twist Drill Co., Cleveland, O.
Fitchburg Machine Works, Fitchburg, Mass.
Krieger Tool & Mfg. Co., Chicago, Ill.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Western Tool & Mfg. Co., Springfield, Ohio.

Diamond Tools

Abrasive Metal Co., Phila., Pa.
American Emery Wheel Co., Providence, R. I.
Dickinson, Thos. L., New York.
Safety Emery Wheel Co., Springfield, O.

Dies, Sheet Metal

American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Boston Tool Co., Cambridge, Mass.
Consolidated Press and Tool Co., Hastings, Mich.
Ferracute Mach. Co., Bridgeton, N. J.
Mossberg Wrench Co., Central Falls, R. I.
Stearns Stamping Co., W. H., Worcester, Mass.
Swaine Mfg. Co., Fred. J., St. Louis, Mo.
Toledo Machine & Tool Co., Toledo, Ohio.

Dies, Sub-Press

Sloan & Chace Mfg. Co., Newark, N. J.
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening

Boker & Co., Hermann, New York.
Errington, F. A., New York.
Foote-Burt Co., Cleveland, O.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Machine Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Drawing Boards and Tables

Alteneder & Son, Theo., Philadelphia, Pa.
Keuffel & Esser Co., Hoboken, N. J.
Kolesch & Co., New York.

Drawing Materials

Alteneder & Son, Theo., Philadelphia, Pa.
Keuffel & Esser Co., Hoboken, N. J.
Kolesch & Co., New York.

Drafting Machines

Universal Drafting Mach. Co., Cleveland, O.

Drilling Machines, Bench

American Watch Tool Co., Waltham, Mass.
Barnes Co., W. F. & John, Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.
Rockford Drilling Mach. Co., Rockford, Ill.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Boiler

American Tool Works Co., Cin., O.
Bickford Drill & Tool Co., Cincinnati, O.
Foote-Burt Co., The, Cleveland, O.
Ingersoll-Rand Co., New York.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Sellers & Co., Inc., Wm., Phila., Pa.

Drilling Machines, Multiple Spindle

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Flather Planer Co., Mark, Nashua, N. H.
Foote-Burt Co., The, Cleveland, Ohio.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.

Drilling Machines, Multiple Spindle—*Continued.*

Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelbhia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Moline Tool Co., Moline, Ill.
Naticdol Machine Co., Hartford, Conn.
Newton Mach. Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Slate Mach. Co., Dwight, Hartford, Conn.
Taylor & Fenn Co., Hartford, Conn.

Drilling Machines, Portable

Cincinnati Elec. Tool Co., Cin., O.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Hisey-Wolf Mach. Co., Cin., O.
Ingersoll-Rand Co., New York.
Newton Machine Tool Wks., Inc., Phila., Pa.
Niles-Bement-Pond Co., New York.
Stow Mfg. Co., Binghamton, N. Y.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Radial

American Tool Works Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cin., O.
Fitchburg Machine Works, Fitchburg, Mass.
Foote-Burt Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Gang Co., Wm. E., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hilbert Mach. Co., Cincinnati, Ohio.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Foundry Co., Jno. B., Cincinnati, O.
Mueller Mach. Tool Co., Cin., O.
Newton Mach. Tool Wks., Inc., Phila., Pa.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.
Wormer Mchy. Co., C. C., Detroit, Mich.

Drilling Machines, Rail

Foote-Burt Co., Cleveland, O.
Newton Machine Tool Wks., Inc., Phila., Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Phila., Pa.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.
Standard Tool Co., Cleveland, O.

Drilling Machines, Turret

Fay Machine Tool Co., Phila., Pa.
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright

American Tool Works Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Burk Machinery Co., Cleveland, Ohio
Burk Machinery Co., Cleveland, Ohio.
Celfor Tool Co., Chicago, Ill.
Cincinnati Mach. Tool Co., Cincinnati, O.
Davis Machine Co., W. P., Rochester, N. Y.
Fosdick Mach. Tool Co., Cin., O.
Foote-Burt Co., Cleveland, O.
Garvin Mach. Co., New York.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.

SPECIAL TESTS

are interesting but the thing that COUNTS is the RESULTS obtained from the use of tools through a series of years.

THE TOOLS THAT HAVE STOOD

THE TEST OF TIME

ARE

"MORSE" TOOLS

DRILLS

Reamers **Taps—Dies**
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Arbors, Counterbores, Countersinks, Gauges, Mandrels, Mills, Screw Plates, Sleeves, Sockets, Taper Pins, Wrenches

Morse Twist Drill & Machine Co.

New Bedford, Mass., U. S. A.

Drilling Machines, Upright —*Continued.*
Hoefer Mfg. Co., Freeport, Ill.
Kern Mach. Tool Co., Cincinnati, O.
Knight Machry. Co., W. B., St. Louis, Mo.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Mechanics Machine Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Machine Co., Hartford, Conn.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Slate Mach. Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Taylor & Fenn Co., Hartford, Conn.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Worner Mchry. Co., C. C., Detroit, Mich.

Drills, Center
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.

Drills, Electric
Independent Pneumatic Tool Co., Chicago, Ill.
Van Dorn Elec. Co., Cleveland, Ohio.

Drills, Flat
Celfor Tool Co., Chicago, Ill.
Lincoln Williams Twist Drill Co., Taunton, Mass.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Drills, Hand
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

Drills, Pneumatic
Clayton Air Compressor Works, New York.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.

Drills, Ratchet
Armstrong Bros. Tool Co., Chicago, Ill.
Billings Spencer Co., Hartford, Conn.
Boker & Co., Hermann, New York.
Cleveland Twist Drill Co., Cleveland, O.
Greene, Tweed & Co., New York.
Hisey-Wolf Mach. Co., Cin., O.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Drills, Rock
Ingersoll-Rand Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.

Drill Speeder
Graham Mfg. Co., Providence, R. I.

Drying Apparatus
Sturtevant Co., B. F., Hyde Park, Mass.

Dynamos
Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.

Dynamos —*Continued.*
Roth Bros. & Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Electric Co., Cincin., O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrical Supplies
Crocker-Wheeler Co., Ampere, N. J.
Cushman Electric Co., Concord, N. H.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cincinnati, O.
Northern Elec. Mfg. Co., Madison, Wis.
Pearce Co., Fred'k, New York.
Roth Bros & Co., Chicago, Ill.
Triumph Electric Co., Cincinnati, O.
Van Dorn Elec. & Mfg. Co., Cleveland, O.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery
American Tool Works Co., Cin., O.
Cincinnati Electrical Tool Co., Cincinnati, O.
Cushman Electric Co., Concord, N. H.
Electro Dynamic Co., Bayonne, N. J.
Hisey-Wolf Mach. Co., Cincin., O.
Ransom Mfg. Co., Oshkosh, Wis.
Roth Bros. & Co., Chicago, Ill.
U. S. Electrical Tool Co., Cincinnati, O.
Van Dorn Elec. & Mfg. Co., Cleveland, O.
Western Electric Co., Chicago, Ill.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Co., Philadelphia, Pa.

Emery Wheels
See Grinding Wheels.

Emery Wheel Dressers
Abrasive Material Co., Phila., Pa.
American Emery Wheel Co., Providence, R. I.
Bay State Stamping Co., Worcester, Mass.
Desmond-Stephan Mfg. Co., Urbana, O.
Diamond Saw & Stamping Works, Buffalo, N. Y.
Dickinson, Thos. L., New York.
Greene, Tweed & Co., New York.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vitrified Wheel Co., Westfield, Mass.
Wrigley Co., Thos., Chicago, Ill.

Enclosures, Tool-Room
Hart & Cooley Co., New Britain, Conn.

Engineering Appliances
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Engineers, Mechanical and Electrical
Crocker-Wheeler Co., Ampere, N. J.
Merritt, Jos., Hartford, Conn.

Engines, Gas and Gasolene
Automatic Mach. Co., Bridgeport, Conn.
Blaisdell Machinery Co., Bradford, Pa.
Grant Mfg. & Mach. Co., Bridgeport, Conn.

Engines, Motor
Franklin Mfg. Co., H. H., Syracuse, N. Y.

Engines, Steam
Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads
Sturtevant Co., B. F., Hyde Park, Mass.

Expanders, Tube
Nicholson & Co., W. H., Wilkes-Barre, Pa.

Factory Sites
Rahway Valley R. R., New York.

Fans, Electric
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Western Electric Co., Chicago, Ill.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Carver File Co., Philadelphia, Pa.
Hammacher, Schlemmer & Co., New York.
National File and Tool Co., Philadelphia, Pa.
Nicholson File Co., Prov., R. I.
Reichhelm & Co., E. P., New York.
Simonds File Co., Fitchburg, Mass.

File Sharpening Machines
American File Sharpener Co., New York.

Filing Machines
Cochrane-Bly Co., Rochester, N. Y.
Henry & Wright Mfg. Co., Hartford, Conn.
Robinson Tool Works, Waterbury, Conn.

Filler, Iron
Clark Cast Steel Cement Co., Shelton, Conn.
Felton, Sibley & Co., Philadelphia, Pa.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Stow Mfg. Co., Binghamton, N. Y.

Forges
Bradley & Son, C. C., Syracuse, N. Y.
Burk Machinery Co., Cleveland, Ohio.
National Machinery Co., Tiffin, O.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
O. K. Tool Holder Co., Shelton, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Foundry Furnishings
Adams Co., Dubuque, Iowa.
Byram & Co., Inc., Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Frictions, Paper and Iron
Rockwood Mfg. Co., Indianapolis, Ind.

Furnaces, Annealing and Tempering
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Hoskins Co., The, Chicago, Ill.
Rockwell Furnace Co., New York.
Tate, Jones & Co., Pittsburg, Pa.

Furnaces, Electric
Hoskins Co., The, Chicago, Ill.

Furnaces, Gas
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Rockwell Furnace Co., New York.
U. S. Gas Furnace Co., Providence, R. I.

Furnaces, Melting
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Obermayer Co., S., Cincinnati, O.

Furnaces, Oil
Burk Machinery Co., Cleveland, Ohio.
Rockwell Furnace Co., New York.
Tate, Jones & Co., Pittsburg, Pa.

Furnaces, Welding
Industrial Oxygen Co., New York.
Sanford Mfg. Co., F. C., Bridgeport, Conn.

Furniture, Machine Shop
Hart & Cooley Co., New Britain Conn.
Merritt & Co., Philadelphia, Pa.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Wks., Jno. M., Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Bristol Co., Waterbury, Conn.
Crosby Steam Gage & Valve Co., Boston, Mass.

Gaskets
Greene, Tweed & Co., New York.
Smooth-On Mfg. Co., Jersey City, N. J.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker Milling Machine Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Bilgram, Hugo, Philadelphia, Pa.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Shaper Co., Cincinnati, Ohio.
Fellows Gear Shaper Co., Springfield, Vt.
Flather Mfg. Co., E. J., Nashua, N. H.
Foote Bros. Gear & Machine Co. Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Newark Gear Cutting Machine Co., Newark, N. J.
Newton Machine Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Schuchardt & Schutte, New York.
Sloan & Chace Mfg. Co., Newark, N. J.
Spacke Mach. Co., F. W., Indianapolis, Ind.
Van Dorn & Dutton Co., Cleveland, Ohio.
Walcott & Wood Mach. Tool Co., Jackson, Mich.
Waltham Machine Works, Waltham, Mass.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Norfolk Downs, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Cincinnati Gear Co., Cincinnati, Ohio.
Clough, R. M., Tolland, Conn.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Machine Co., Philadelphia, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Fawcus Mach. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Flather Mfg. Co., E. J., Nashua, N. H.
Foote Bros. Gear & Machine Co., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.

A New High Speed Milling Cutter—II

The Development of an Inserted Blade Cutter Giving Record Breaking Results. Comprehensive Tests of Power Consumed by Milling Machines

BY WILLIAM H. TAYLOR*

Advantages of Lubrication

Too much stress cannot be laid upon the use of a lubricant during the process of milling. A copious stream of lubricant falling at slow velocity should be thrown directly upon the chip at the point it is being removed.

Heat generated by the pressure of the chip is the chief cause of wear, and if it is allowed to become too great it will soften the lip surface of the blades and cause them to crumble or spall off. Therefore it is apparent that an ample supply of lubricant during the milling operation, not only decreases the friction, but also carries off the heat, thereby preventing a dulling of the cutting edges and eliminating any possibility of their crumbling or spalling due to excessive heat.

It has been conclusively shown by experiment that a gain of 33 per cent. in the permissible cutting speed may be obtained from a heavy stream of lubricant upon the cutter and along its entire face in milling steel and wrought iron, and a gain of 15 per cent. in milling cast iron.

The piping conveying the lubricant to the milling cutter should be arranged with a sufficient number of nozzles, spaced about 4 inches apart, to cover the face of the cutter. The main supply pipe to the nozzles should be large enough to supply each nozzle with from two to three gallons of lubricant per minute. The general arrangement, size of supply pipe, and number of nozzles will be regulated by the width of the machine and the nature of the work to be done.

In the more recent design of slab milling machines due consideration has been given to the requirements of ample lubrication. The platen is drained by gravity to a tank located at the side of the machine from which the lubricant is raised by a pump to a reservoir formed by the cross piece at the top of the housings, to which is attached the nozzle bracket which conveys the lubricant to the required point by gravity.

In reply to the question, What lubricant is best for heavy milling? the answer is that the so-called lubricating fluid should not be considered as a lubricant,

*The Tabor Manufacturing Company.

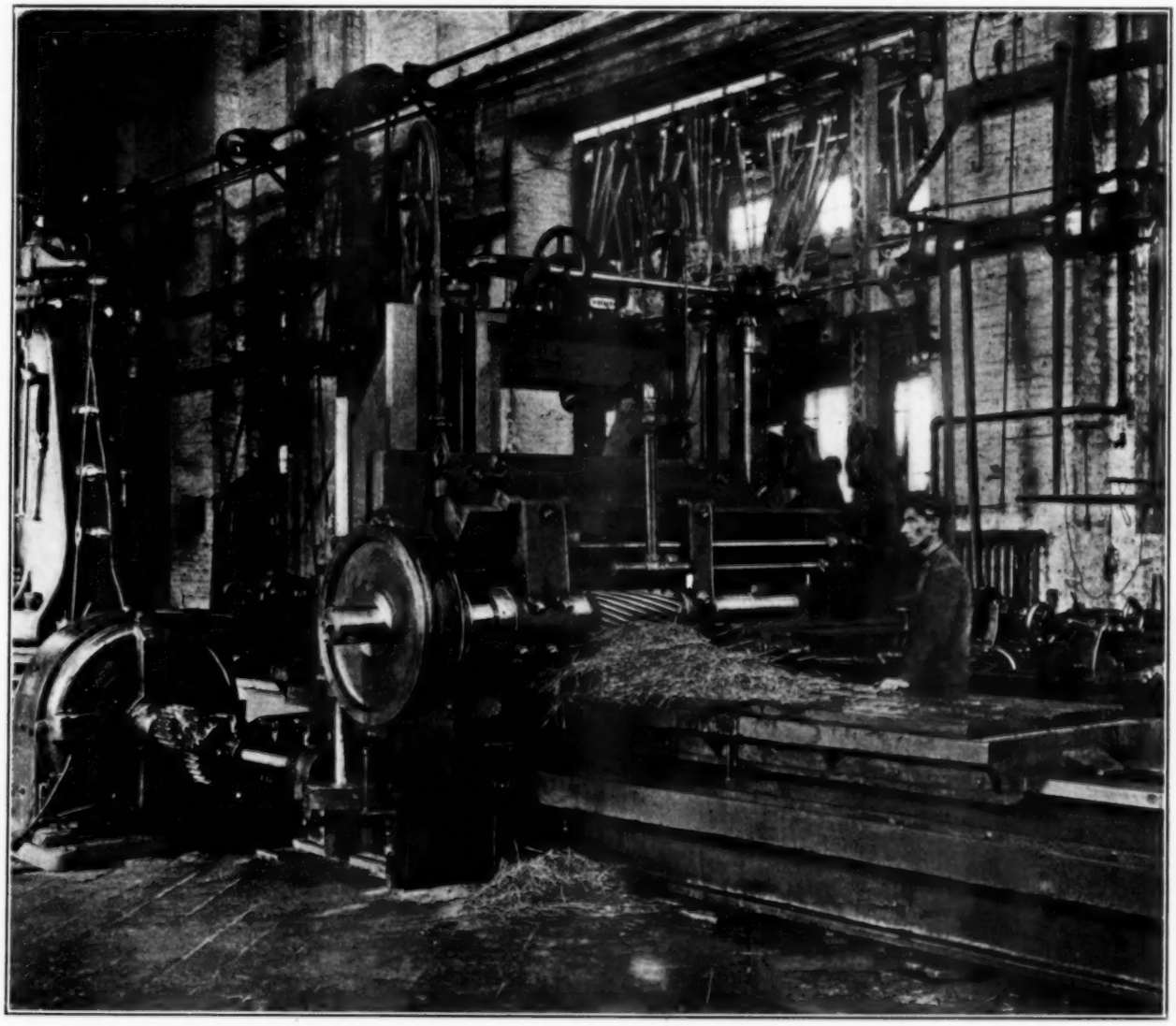


FIG. 12. BEMENT-MILES WORM DRIVEN MILLING MACHINE ON WHICH TESTS GIVEN IN TABLE I WERE MADE

but as a means of carrying off the heat generated. The compound cannot act as a lubricant between the forging and the cutter blades, for it is virtually impossible to force a lubricant between the forging and the blade during the milling operation owing to the enormous cutting pressure, say 300,000 pounds per square inch as a fair average. It is also impossible to provide any mechanical device for conducting the fluid to the required point. However, a lubricating compound eliminates friction between chip and blade as the chip is being sheared from the forging.

Water with the addition of soap or soda to prevent rusting of the finished parts of the machine is, in all probability, the best medium for the purpose, although there are a number of screw-cutting compounds which are equally successful.

Number of Test.	CUT.							SPEED OF CUTTER.		ELECTRICAL READINGS. Driving and Feed Motors Included.			Horsepower per Cubic Inch Removed per Minute.	Cubic Inches Removed per Minute per Inch of Width of Cutter.	DURATION OF TEST.	
	FEED.		Depth, Inches.	Width, Inches.	MATERIAL REMOVED.											
	Table Advance per Minute, Inches.	Advance per Blade, Inches.			Cubic Inches per Minute.	Pounds per Minute.	Pounds per Hour.	R.P.M.	Feet per Minute.	Amperes.	Volts.	Gross Horsepower.			Minutes.	Seconds.
1								24	50.26	18	230	5.55				
2	1¼	0.00277	¼	18	7.87	2.23	133.77	35	73.30	100	218	29.22	3.71	0.093	11	23
3	5/16	0.00942	5/16	18	13.36	3.78	227.09	35	73.30	110	217	32.00	2.39	0.742	3	36
4	6⅜	0.01012	⅜	18	14.34	4.06	243.75	35	73.30	120	215	34.58	2.41	0.796	3	18
5	7¼	0.01184	¼	18	16.31	4.62	277.23	34	72.36	120	210	33.75	2.06	0.906	2	45
6	8	0.01307	¼	18	18.00	5.09	305.96	34	72.36	130	205	35.72	1.98	1.000	2	30
7	8	0.01481	5/16	18	27.00	7.65	458.94	30	62.87	190	208	54.88	2.03	1.500	2	30
8	8⅝	0.01861	⅜	18	28.27	8.01	480.53	25	52.36	200	195	52.27	1.84	1.570	2	21

TABLE 1. SLAB MILLING STEEL.

Machine Used.—Bement-Miles 43-inch worm-driven slab-milling machine.
Driving Motor.—Westinghouse, direct-current, constant-speed type, 43-horsepower rated capacity. Direct connected.
Feed Motor.—Westinghouse, direct-current, constant-speed type, 5-horsepower rated capacity. Direct connected.
Cutter Used.—Taylor-Newbold high-speed milling cutter, 18-inch face, 8-inch nominal diameter, 8¼-inch actual diameter, 3½-inch bore, 18 inserted blades, ⅜ inch thick and 1⅛ inches wide with ⅜-inch overhang.
Material Cut.—0.30-per cent. carbon-steel forging 18 inches wide, 20 inches long.
Test made at Bement-Miles works, Philadelphia, Penn., May 25, 1908.

CHATTER

Chatter is the most obscure and delicate of all problems confronting the machinist in the case of milling castings and forgings of miscellaneous shapes. Probably no rule or formula can be devised which can guide the machinist in taking the maximum cuts and speeds possible without producing chatter. In milling, chatter is produced by many causes, such as the shape of the cutting edges, the design of the machine, the use of too light an arbor and carelessness in grinding.

Chatter caused by the design of the ma-

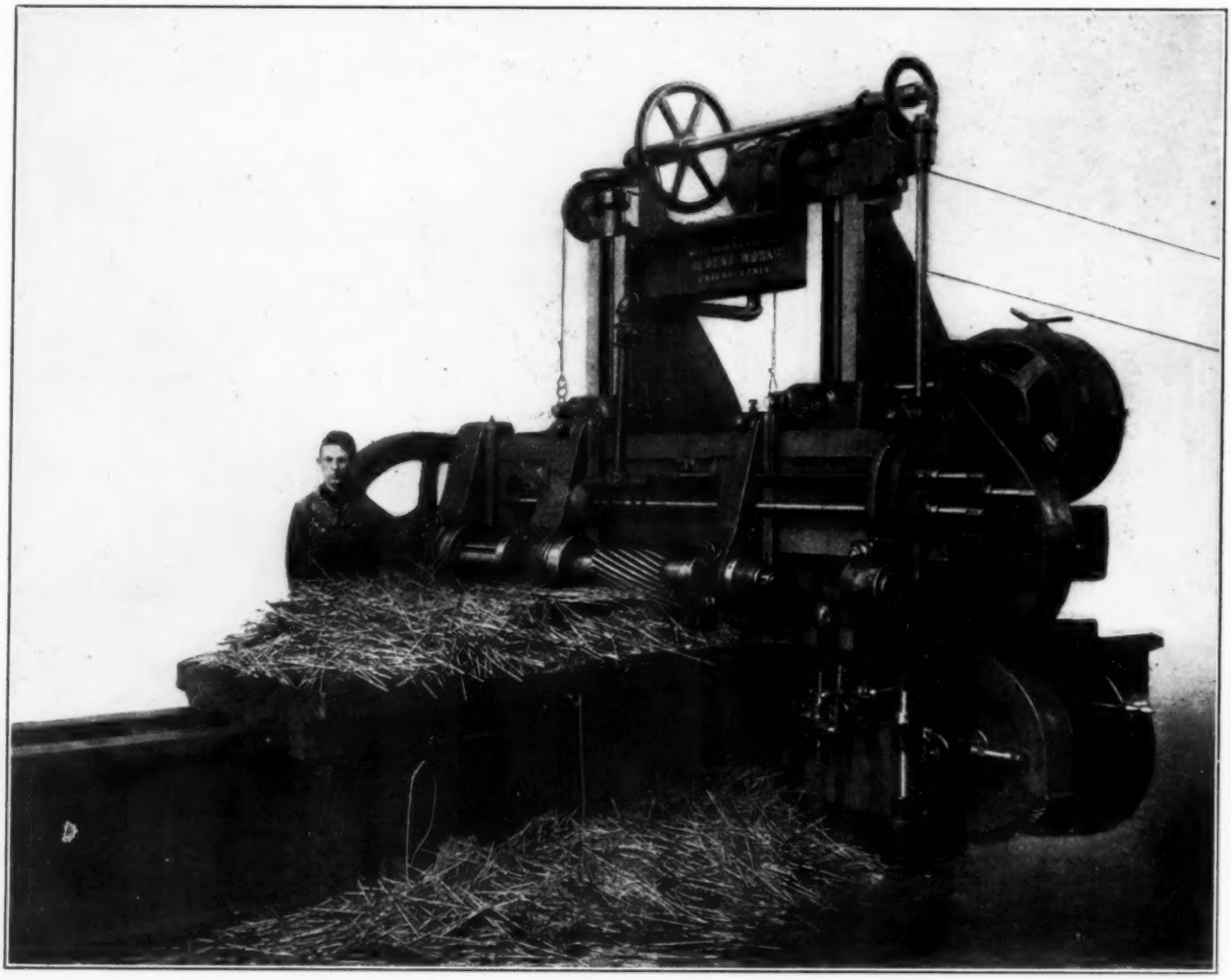


FIG. 13. BEMENT-MILES SPUR-GEAR DRIVEN SLABBING AND CHANNELING MACHINE ON WHICH TESTS GIVEN IN TABLE 5 WERE MADE. THIS MACHINE ESTABLISHED THE RECORD FOR HEAVY SLAB MILLING—82 CUBIC INCHES OF 0.25 PER CENT. CARBON STEEL PER MINUTE

chine is outside the control of the machinist. Among the principal causes are badly made and fitted gears, shafts which are too small in diameter or too great in length, and loose fits in bearings and slides. High cutting speeds tend far more than low speeds toward producing minute and rapid vibration in all parts of the machine. These vibrations are best opposed and absorbed by the proper distribution of large masses of metal supporting the cutting tool, and in the bed and platen. Chatter is frequently caused by mounting the driving gears upon shafts either too small in diameter or too long. A large excess in diameter of shaft beyond that required for strength is called for in order to avoid torsional deflection which produces chatter. Milling-machine spindles and shafts must be very accurately and closely fitted in their bearings, and the caps adjusted so as to avoid all play. The bed and platen should be exceedingly massive, and should contain far more metal than is required for strength or even to resist ordinary deflections.

The avoidance of chatter in the cutter plays an important part in the design of the curve in the cutting edge for milling-cutter blades. It is evident that when the thickness of the shaving is uniform the period of high pressure will arrive at all points along the cutting edge at the same instant, and will be followed an instant later by a corresponding period of low pressure, and that when these periods of maximum and minimum pressure approximately correspond to or synchronize with the natural periods of vibration, either in the forging, the milling cutter, the arbor or any part of the driving mechanism of the machine, there will be a resultant chatter in the work. On the other hand, in the case of blades with curved cutting edges, the thickness of the shavings varies at all points along the cutting edge, and from this fact it is obvious that when the highest pressure, corresponding to one thickness of shaving along the curved cutting edge is reached, the lowest pressure, which corresponds to another thickness of shaving at another part of the cutting edge is likely to occur at about the same time, and therefore variations up and down in pressure at different parts of the curve will balance or compensate one another. It is evident, moreover, that at no one period of time can the wave of high pressure or low pressure extend along the whole length of the curved cutting edge. It is apparent that blades with curved cutting edges produce chips which may vary in thickness, while those with straight cutting edges produce chips uniform in thickness; therefore, the latter chip being of uniform thickness causes chatter, and the proper remedy for this is to use a curved blade, which is always accompanied by a chip of an uneven thickness.

One of the most frequent causes for chatter in milling lies in having too light or too springy an arbor for heavy work. The cutter is under high cutting pressure, and if the arbor is not of a diameter in excess of that required for strength it will develop torsional deflection which produces chatter, and will also require a greater amount of power to drive it, owing to the fact that an arbor which is deflected will bind in its bearings. Great

Number of Test.	CUT. Feed. Table Advance per Minute, Inches.	CUT. Feed. Advance per Blade, Inches.	CUT. Depth, Inches.	CUT. Width, Inches.	CUT. Material Removed. Cubic Inches per Minute.	CUT. Material Removed. Pounds per Minute.	CUT. Material Removed. Pounds per Hour.	Speed of Cutter. R.P.M.	Speed of Cutter. Feet per Minute.	Electrical Readings. Driving and Feed Mechanisms Includ'd. Amperes.	Electrical Readings. Driving and Feed Mechanisms Includ'd. Volts.	Electrical Readings. Driving and Feed Mechanisms Includ'd. Gross Horsepower.	Horsepower per Cubic Inch Removed per Minute.	Cubic Inches Removed per Minute per Inch of Width of Cutter.	Duration of Test. Minutes.	Duration of Test. Seconds.
1								25	53.5	28	220	8.25				
2	3½	0.00636	½	15	26.25	6.83	410.13	25	53.5	150	200	40.21	1.53	1.75	10	2
3	5½	0.01332	½	15	44.06	11.47	688.38	24.5	51.33	150	220	44.23	1.00	2.94	6	8
4	7½	0.01736	½	15	56.25	14.74	737.33	24	50.25	160	208	44.70	0.794	3.75	4	48
5	6½	0.01361	½	15	45.93	11.96	717.72	25	53.5	175	208	48.79	1.06	3.06	5	5
6	7½	0.01722	½	15	58.12	15.13	908.14	25	53.5	225	200	60.32	1.03	3.87	4	39
7	7½	0.01781	½	15	50.70	13.20	792.13	23	48	260	204	70.96	1.39	3.38	4	53
8	7½	0.01781	½	15	50.70	13.20	792.13	23	48	.....	.....	.....	.....	.....	3	39
9	8	0.01851	½	15	82.50	21.48	1288.98	24	50.25	240	213	68.52	0.830	5.50	1	15
10	7	0.0176	1	15	105.00	27.34	1640.52	22	47	350	190	89.14	0.849	7.00	3	17

TABLE 2. SLAB MILLING CAST IRON.

Machine Used.—Bement-Miles 42-inch spur-driven slab-milling machine.
Driving Motor.—Westinghouse, direct-current, constant-speed type, 40-horsepower rated capacity at 220 volts and 153 amperes. Belt connected, 11-inch double leather belt.
Cutter Used.—Taylor-Newbold high-speed milling cutter, 18-inch face, 8-inch nominal diameter, 8½-inch actual diameter, 3½-inch bore, 18 inserted blades, ½ inch thick and 1½ inches wide with ¾-inch overhang.
Material Cut.—Cast-iron test block 15 inches wide, 36 inches long.
Test made at Bement-Miles Works, Philadelphia, Penn., July 13, 1908.

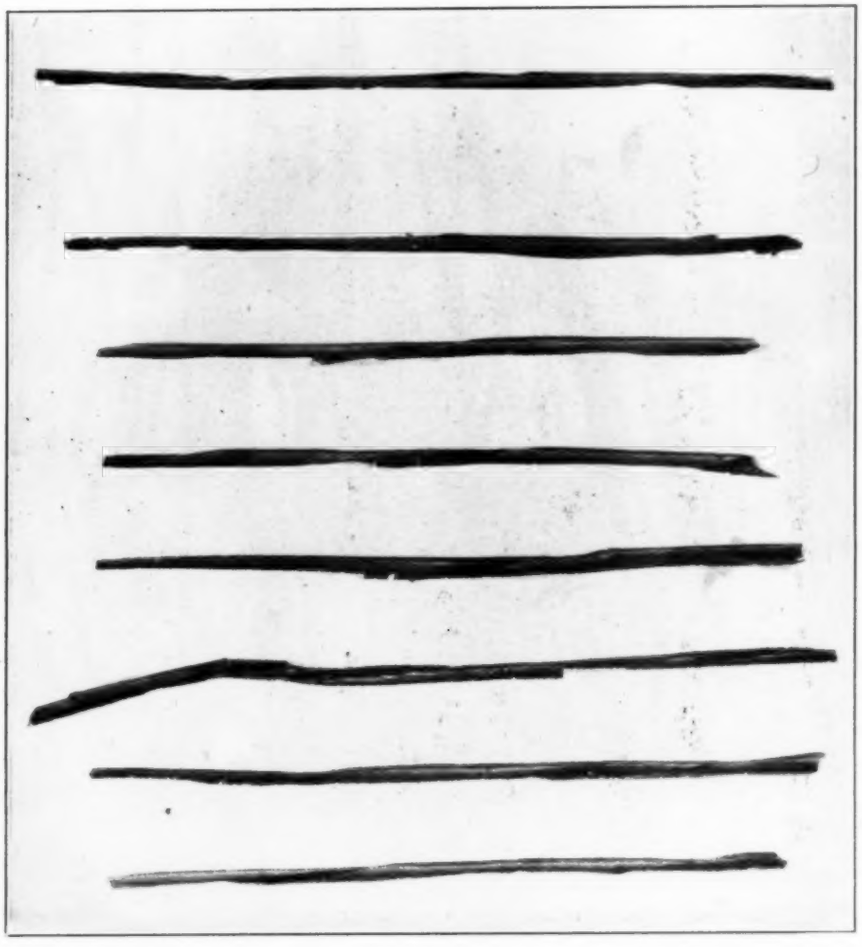


FIG. 14. STEEL CHIPS MILLED FROM 0.57 PER CENT. CARBON-STEEL FORGING 18 INCHES WIDE AT THE RATE OF 47¼ CUBIC INCHES PER MINUTE. THE CHIPS VARY BETWEEN 14 AND 16½ INCHES IN LENGTH

care should be exercised when fitting the arbor and cutter to the milling machine to see that the bearings supporting the spindle and the arbor are moved up as close as is possible to the milling cutter, and that the collars used between the bearings and cutter are of the largest permissible diameter. The diameter of the milling cutter as compared with the diameter of the arbor is also a factor for consideration. The greater the distance between the periphery of the cutter and the arbor the greater the liability of the arbor to spring and cause chatter. When selecting a cutter for high-speed milling on a high-powered machine more satisfactory results can be obtained by using a cutter of smaller diameter which permits the use of a large arbor. The smaller the cutter the higher the number of revolutions for any given cutting speed and the limiting capacity of the arbor depends on its diameter and revolutions per minute.

Chatter may also be produced in a milling cutter which has not been ground concentric so as to distribute as nearly as possible an even cutting pressure upon all the blades. Milling cutters may be seen in operation that have been ground eccentric to such an extent that only two-thirds of the blades remove the metal.

A milling cutter which chatters to any great extent must be run at a slower cutting speed, by say from 10 to 15 per cent., than a cutter which runs free from chatter, whether with or without a heavy stream of lubricant.

Grinding Milling Cutters

A sharp cutter will stand a higher cutting speed than a dull one. The duller a cutter the more heat will be generated per revolution, and to prevent this heat the revolutions must be lowered.

It is also essential that milling cutters be ground on a grinding machine adapted to the purpose. Cutters with blades helical in shape should be ground preferably on a machine in which the arbor supporting the cutter is rotated by power, rather than by resting the front face of the blades on a finger and, rotating and moving the cutter longitudinally by hand to follow the line of the helix. It is a very difficult matter to fit the machine with a sufficiently rigid finger, and variations due to the spring of the finger will cause eccentricity in the periphery of the cutter or in other words the cutting edge will not be concentric with the axis.

The first operation is to grind the cutter cylindrical with the periphery concentric to its axis, the second to form the proper clearance angle by backing off. Machines which fulfil these conditions are manufactured by the Landis Tool Company, Waynesboro, Penn., and the Norton Grinding Company, Worcester, Mass.

Power Tests of Milling Machines

In the tests tabulated hereinafter the amount of power consumed by the mill-

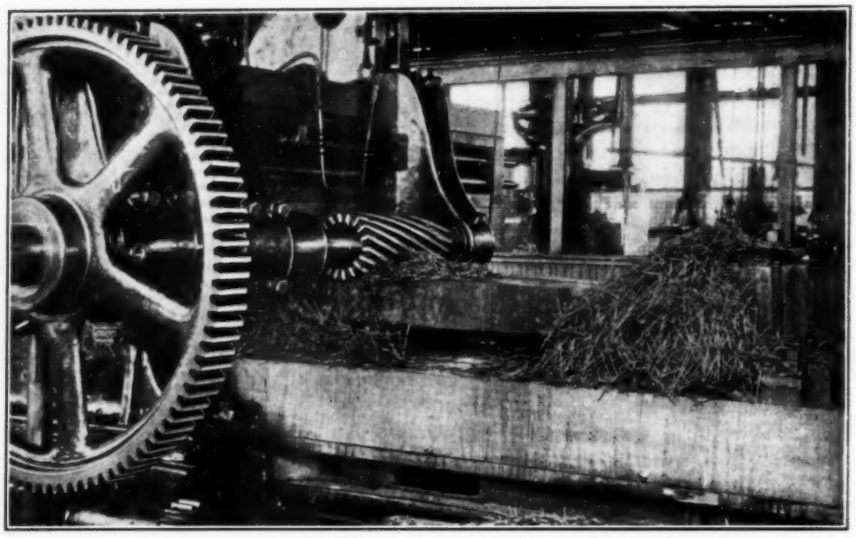


FIG. 16. MILLING THE UPPER EDGE OF THE CENTER PORTION OF TWO LOCOMOTIVE CONNECTING RODS. DEPTH OF CUT FROM 3/8 TO 5/8 INCH, ADVANCE 5½ INCHES PER MINUTE

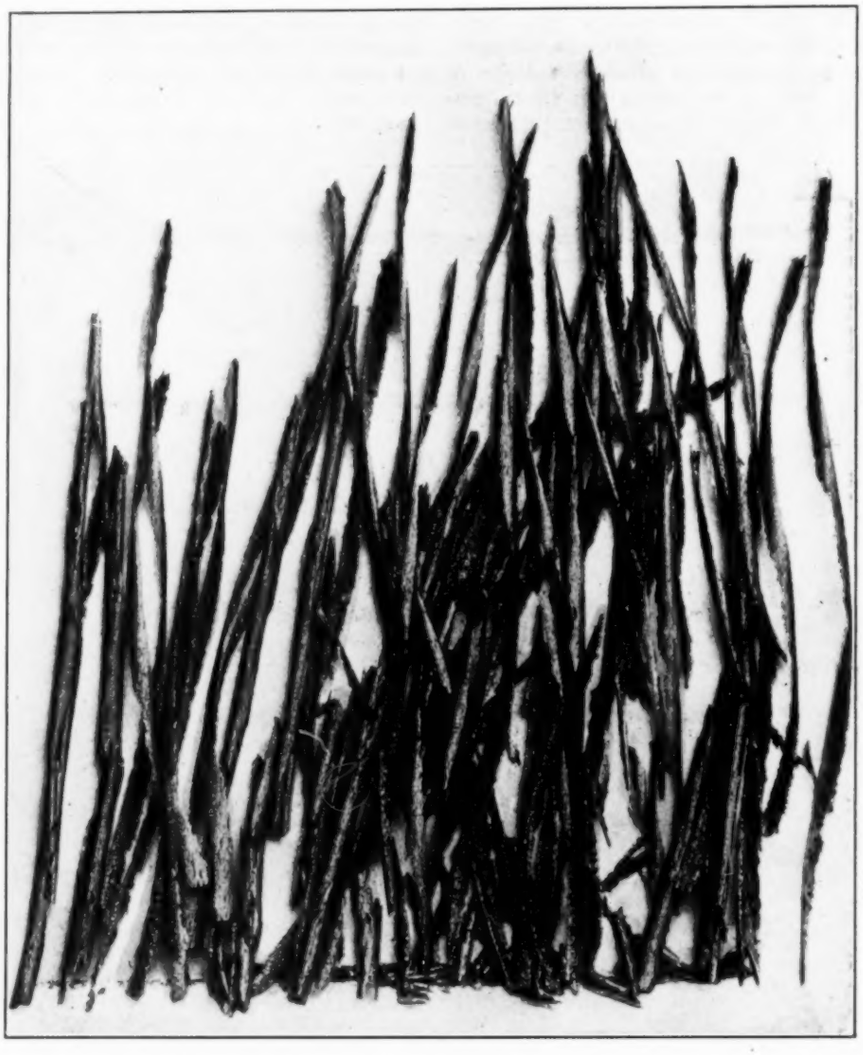
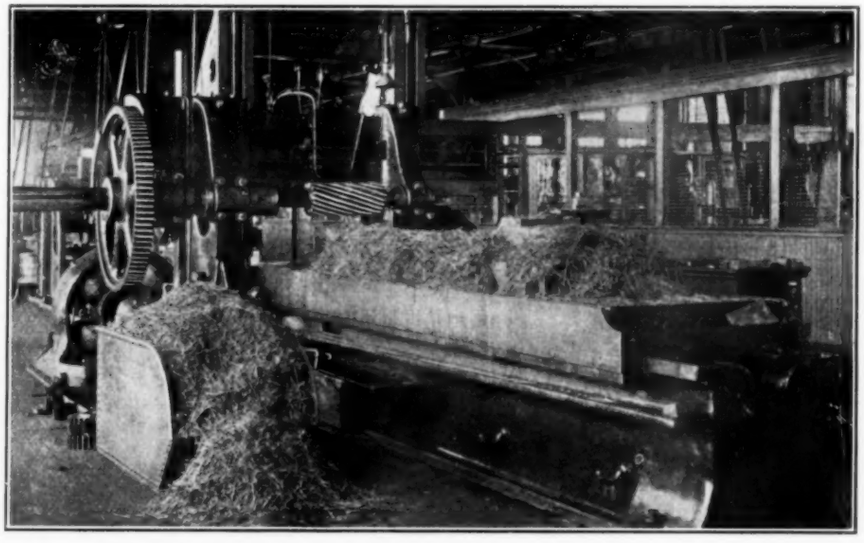


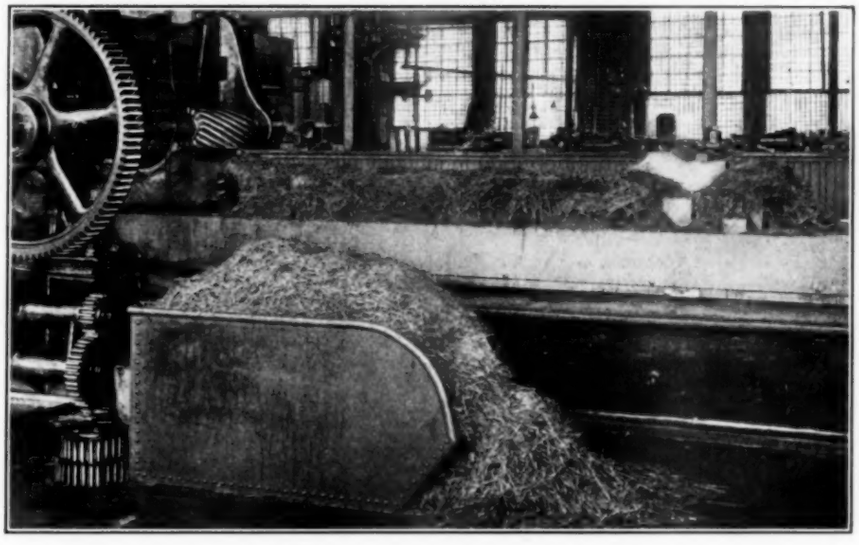
FIG. 15. CAST-IRON CHIPS MILLED FROM A SURFACE 14 INCHES WIDE. THESE CHIPS WERE REMOVED AT THE RATE OF 105 CUBIC INCHES PER MINUTE AND AS A WHOLE ARE STRAIGHT AND CYLINDRICAL IN SHAPE. THEY AVERAGE ABOUT 12 INCHES IN LENGTH AND ARE STRONG ENOUGH TO SUPPORT THEMSELVES WHEN STANDING ON END

Number of Test.	CUT. Feed. Table Advance per Minute, Inches.	CUT. Feed. Advance per Blade, Inches.	CUT. Depth, Inches.	CUT. Width, Inches.	CUT. Material Removed. Cubic Inches per Minute.	CUT. Material Removed. Pounds per Minute.	CUT. Material Removed. Pounds per Hour.	Speed of Cutter. R.P.M.	Speed of Cutter. Feet per Minute.	Electrical Readings. Driving and Feed Mechanisms Includ'd. Amperes.	Electrical Readings. Driving and Feed Mechanisms Includ'd. Volts.	Electrical Readings. Driving and Feed Mechanisms Includ'd. Gross Horsepower.	Horsepower per Cubic Inch Removed per Minute.	Cubic Inches Removed per Minute per Inch of Width of Cutter.	Duration of Test. Minutes.	Duration of Test. Seconds.
1								35	73.33	29	220	8.54				
2	11¼	0.01785	1/16	18	31.64	8.96	537.81	35	73.33	190	220	56.03	1.77	1.76	1	47
3	11¼	0.01785	1/8	18	63.28	17.92	1075.62	35	73.33	...	...	.....	.....	3.51	...	11
4	6¾	0.01041	1/16	18	43.03	12.19	731.44	34	71	300	195	78.41	1.82	2.39	1	30
5	7	0.01080	1/16	18	47.25	13.38	801.15	36	75.5	400	180	96.51	2.04	2.62	1	26
6	7	0.00925	1/16	18	47.25	13.38	801.15	42	88	370	187	92.74	1.96	2.62	2	51

TABLE 3. SLAB MILLING STEEL.

Machine Used.—Bement-Miles 42-inch spur-driven slab-milling machine.
Driving Motor.—Westinghouse, direct-current, constant-speed type, 40-horsepower, rated capacity at 220 volts and 153 amperes. Belt connected, 11-inch double belt.
Cutter Used.—Taylor-Newbold high-speed milling cutter, 18-inch face, 8-inch nominal diameter, 8¼-inch actual diameter, 3½-inch bore, 18 inserted blades ⅜ inch thick and 1⅜ inches wide, with ⅜-inch overhang.
Material Cut.—0.30-per cent. steel forging 18 inches wide, 20 inches long.
Test made at Bement-Miles works, Philadelphia, Penn., July 14, 1908.





FIGS. 17 AND 18. TWO VIEWS OF MACHINE SHOWING 720 POUNDS OF CHIPS, THE RESULT OF ONE HOUR'S MILLING

ing machine, as read from the voltmeter and ammeter will be given. Dynamometer readings of the actual power exerted at the spindle, or the amount of power consumed by friction in the gearing and bearings will not be given consideration, as the user is most interested in the commercial readings, indicating the amount of power for which he has to pay.

Credit is due the Bement-Miles works of the Niles-Bement-Pond Company, of Philadelphia, Penn., for furnishing the use of various types of high-powered milling machines, and rendering valuable assistance in carrying out the experiments and tests.

In presenting the tables no data concerning efficiency tests of the milling machines are given, but a series of exhaustive tests in the near future, taking in the various types of high-powered milling machines marketed by the different manufacturers is in contemplation. The only efficiency tests with which I am acquainted were made by the Cincinnati Milling Machine Company and, through their engineer Mr. DeLeeuw, presented at the December meeting of the American Society of Mechanical Engineers and republished on page 277 of the AMERICAN MACHINIST. These tests related to the knee-type milling machine, which must possess higher efficiency than the heavy type of slab milling machine owing to the heavy trains of driving gears required by the latter.

Mr. DeLeeuw offers as the best results obtained in slab milling from 0.45 to 0.55 cubic inch per minute from one horsepower actually consumed by the milling cutter in cutting 0.16 per cent. carbon steel. His citation relative to the better results which he obtained with a face mill as compared with a slab mill, ascribing the difference due to the lip angle of the cutter are also noted. There is no inherent advantage in face milling over slab milling if the cutting edges in both types of cutter are alike, and these experiments on slab milling bear out this opinion. Particular attention is called to the very pronounced lip angle obtained by the use of curved blades, as already shown, and as far as actual performance is concerned experiments demonstrate that it is possible to obtain with this cutter from 1 to 1½ cubic inches of 0.25-per cent. carbon steel per minute against ½ cubic inch of 0.16-per cent. carbon steel obtained by Mr. DeLeeuw. This output is estimated on a basis of 70 per cent. for the combined efficiency of motor and slab machine, and this we believe to be a higher figure than could be established by experiments upon efficiency on account of the longer train of gearing used on the larger machine. Probably 60 per cent. would be nearer the truth, and on this basis the amount of metal removed per horsepower would run from 1¼ to 1½ cubic inches.

All these experiments were made with a milling cutter 8 inches diameter, 18 inches face, 3½ inches bore, having 18

high-speed steel blades on high-powered slab milling machines weighing from 40,000 to 70,000 pounds and driven with a 100-horsepower motor. The readings include the amount of power necessary to drive the feed mechanism, whereas the machines are cataloged by the makers with independent driving and feeding motors of lesser capacity.

Table 1 shows what we accomplished on the worm-driven machine illustrated in Fig. 12.

Number of Test.	CUT. Feed. Table Advance per Minute, Inches.	CUT. Feed. Advance per Blade, Inches.	CUT. Depth, Inches.	CUT. Width, Inches.	CUT. Material Removed. Cubic Inches per Minute.	CUT. Material Removed. Pounds per Minute.	CUT. Material Removed. Pounds per Hour.	Speed of Cutter. R.P.M.	Speed of Cutter. Feet per Minute.	Electrical Readings. Driving and Feed Mechanisms Includ'd. Amperes.	Volts.	Gross Horsepower.	Horsepower per Cubic Inch Removed per Minute.	Cubic Inches Removed per Minute per Inch of Width of Cutter.	Duration of Test. Minutes.	Seconds.
1								39	82.95	35	220	10.32				
2	6¼	0.0132	5/16	4⅜	9.40	2.66	159.78	37	78.69	85	200	22.74	2.42	2.14	3	25
3	1⅛	0.00307	1	4⅜	8.48	2.40	144.14	35	74.44	95	185	23.56	2.77	1.93	7	12
4	1½	0.00231	1	4½	6.56	1.86	111.51	36	76.57	85	193	21.85	3.33	1.49	4	....
5	2⅛	0.00394	1 1/16	4½	15.07	4.27	256.15	37	78.69	113	200	30.29	2.00	3.44	2	40
6	3⅛	0.00544	1 5/16	4½	20.81	5.89	353.72	37	78.69	135	195	35.28	1.69	4.75	1	56
7	5	0.0075	1 5/16	4½	28.71	8.13	488.01	37	78.69	200	190	50.93	1.77	6.56	1	24

TABLE 4. MILLING CHANNELS.

Machine Used.—Bement-Miles 42-inch spur-driven slab-milling machine.
Driving Motor.—Westinghouse, direct-current, constant-speed type, 40-horsepower, rated capacity at 220 volts and 153 mperes. Belt connected, 11-inch double leather belt.
Cutter Used.—Taylor-Newbold high-speed channeling milling cutter, 4½-inch face, 8-inch nominal diameter, 8¼-inch actual diameter, 3½-inch bore, 18 inserted blades ⅜ inch thick and 1⅜ inches wide, with ⅛-inch overhang.
Material Cut.—0.30-per cent. carbon steel forging.
Test made at Bement-Miles works, Philadelphia, Penn., October 20, 1908.

Number of Test.	CUT. Feed. Table Advance per Minute, Inches.	CUT. Feed. Advance per Blade, Inches.	CUT. Depth, Inches.	CUT. Width, Inches.	CUT. Material Removed. Cubic Inches per Minute.	CUT. Material Removed. Pounds per Minute.	CUT. Material Removed. Pounds per Hour.	Speed of Cutter. R.P.M.	Speed of Cutter. Feet per Minute.	Electrical Readings. Driving and Feed Motors Included. Amperes.	Volts.	Gross Horsepower.	Horsepower per Cubic Inch Removed per Minute.	Cubic Inches Removed per Minute per Inch of Width of Cutter.	Duration of Test. Minutes.	Seconds.
1								33	70.19	30	222	8.92				
2	7½	0.0132	3/16	11½	56.60	16.03	962.08	32	68.05	375	190	95.50	1.68	4.92	6	4
3	5½	0.0095	1 1/32	11½	65.22	18.47	1108.60	32	68.05	375	198	99.53	1.52	5.67	9	5
4	9½	0.0133	3/16	11½	71.69	20.31	1218.58	35.5	75.50	425	235	133.87	1.86	6.23	5	21
5	9½	0.0155	¼	11½	82.00	23.23	1393.81	34	72.31	550	220	162.19	1.99	7.13	5	21

TABLE 5. SLAB MILLING STEEL.

Machine Used.—Bement-Miles 45-inch spur-driven heavy rod slabbing and channeling machine.
Driving Motor.—Westinghouse, direct-current, variable-speed type, 65-horsepower, rated capacity at 220 volts and 245 amperes. Ratio 2 to 1. Direct connected.
Feed Motor.—Westinghouse, direct-current, variable-speed type, 8½-horsepower, rated capacity at 220 volts and 40.5 amperes. Ratio 4 to 1. Direct connected.
Cutter Used.—Taylor-Newbold high-speed milling cutter, 18-inch face, 8-inch nominal diameter, 8¼-inch actual diameter, 3½-inch bore, 18 inserted blades ⅜ inch thick, 1⅜ inches wide, with ⅛-inch overhang.
Material Cut.—0.25-per cent. carbon-steel forging, 11½ inches wide by 50 inches long.
Test made at Bement-Miles works, Philadelphia, Penn., November 19, 1908.

Tests given in Tables 2, 3 and 4 covering slabbing of cast-iron and steel forgings and channeling steel forgings were made on a spur-driven machine rated at 30 horsepower capacity.

Tests given in Table 5 were made on an extra heavy spur-driven slabbing and channeling machine rated at 65 horsepower capacity, and illustrated in Fig. 13.

It will be of interest to know that the conditions under which the milling cutter and machine operated, as given in Table 5 and illustrated in Fig. 13, were more severe than has ever been attempted in slab-milling practice with any type of milling cutter or milling machine, and in this connection I would say that we traversed a steel forging 11½ inches wide and 50 inches long five times without sharpening the cutter, and after this performance there was no perceptible dullness of the cutting edge. The first two runs were made with a table advance of 9½ inches and a depth of cut of 21/32 inch, the circumference of the cutter being under approximately 25,000 pounds cutting pressure. The third run was made with a table advance of 5½ inches per minute, and a depth of cut of 1 1/32 inches with the cutter under approximately 26,000 pounds cutting pressure, and runs four and five were made with a table advance of 9½ inches per minute, ¾ inch depth of cut with the circumference of the cutter under approximately 39,000 pounds cutting pressure, making a total of 30½ minutes actual cutting time in which the milling cutter traversed 250 inches, and removed 607 pounds of 0.25-per cent. carbon steel. A cutting speed of from 68 to 75 feet per minute was maintained.

Some Interesting Shop Tools and Methods

Among the interesting shop tools and methods of the American Gas Furnace Company, Elizabeth, N. J., are some of their tools for making their pressure blowers, which are used in connection with their gas furnaces. These blowers consist of a cast-iron case, containing four blades driven by a shaft set out of center with the case. This necessitates the case being bored with an eccentric boring bar, as shown in Fig. 1. The boring bar consists of two main parts, the inner or eccentric bar which is held between centers and is prevented from turning by the L-shaped clamp shown at the extreme left. Around this is a sleeve or quill, carrying the cutter head, which is shown inside the casing, and also the two facing heads, which have the appearance of being face plates. These are operated in the usual way by star feeds, and are used for facing off both sides of the case at once. The cutters are free to move in and out of the heads, being forced out at the proper time by a cam on the inner shaft and being controlled in the other direction by the heavy spring shown. In this way it is a very easy matter to bore an odd shape and secure exactly the desired contour so that the blades will make a perfect contact at all positions during their revolution.

A Bell Chuck

Fig. 2 shows a bell chuck for holding the end pieces which go on the blower and carry the shaft. These are quite large in diameter and are not particularly easy to hold in a chuck. So the bell chuck shown has been made for this purpose. First the small levers with the pin handles *A* are thrown down, so that the end projects out beyond the end of the jaw or stop to which this lever is attached. The rough casting is then pushed back against these pieces, which form a temporary stop, and the nuts *B* are tightened, which raises the long end of the gripping jaws *C* and forces the short, outer arm against the castings as shown. Then the set screw *D* is fastened against the end of the bearing, the levers are thrown back to the position shown, and the stop screw *E* is screwed into contact with the inside of the rim and clamped in this position by the small thumb screws on the other side from the temporary adjusting levers. After this everything is plain sailing, and the pieces are held very firmly and can be turned quickly.

Cutting Spiral Oil Grooves

Fig. 3 shows a small machine which has

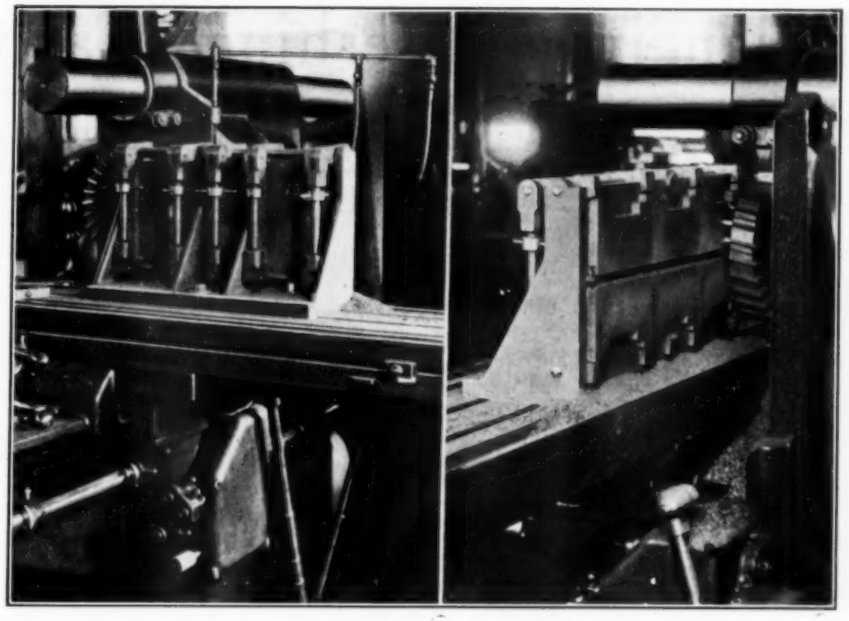
been made to cut the spiral oil grooves in the bearings formed on the end of the pieces being turned in Fig. 2. The upper view shows one of these pieces in place, and the lower view the end of the bar carrying the cutter, the three dowel pins for locating the bearing plate and the thumb screws for clamping these in positions. In both views is a sleeve carrying the spiral groove which acts as a guide for this cutter. The machine can be operated either by hand or by a belt on the rim of the pulley, and the piece of shaft next to the pulley is threaded so as to pull the cutting bar lengthwise of the bearing.

The cut is started at the outer end of the bearing, and as shown in the upper view, is just completed. This gives a drawing cut which holds the work up against the plate, so that all the clamps have to do is prevent its slipping sideways. The sleeve containing the spiral groove is fastened in the forward bearing, and the cutter bar passes through this, a pin in the bar following the spiral groove and producing the desired rotation of the cutting tool, and likewise of the oil groove in the box.

Holding Thin Pieces

Figs. 4 and 5 show the milling fixture used in milling the sides of the blades used in these pressure blowers. These are comparatively thin, and it is not an easy matter to clamp them for milling so as to entirely obviate springing. This device, however, holds them very nicely and seems to get away from this difficulty. As shown in Fig. 4, there are two strings of three each in the fixture, being clamped both top and bottom against a central abutment, one of these being shown at the end between the two blades. Fig. 5 shows how these clamps are operated, both clamping levers floating so that any variation in the width of the blade can be taken care of, and both will be drawn against the central abutment with equal pressure.

The five pairs of clamps shown in Fig. 5 make this suitable for two sizes of blades. As shown in Fig. 4, three pairs are being clamped by four of the holders, the central clamp being idle. On a larger size blade the central and two end clamps will hold two pair similarly.



FIGS. 4 AND 5. BACK AND FRONT VIEW OF MILLING FIXTURE

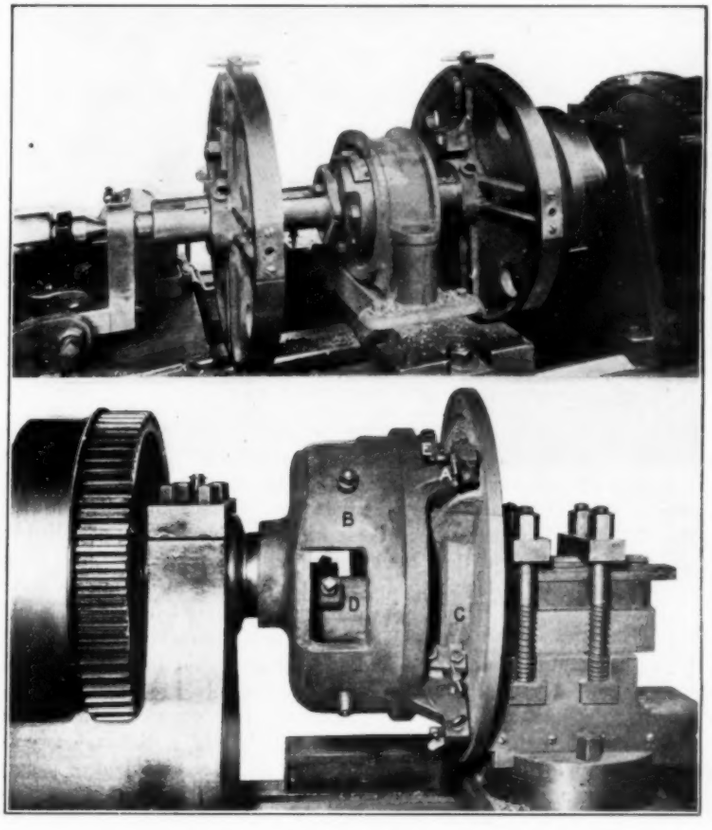


FIG. 1. BORING AN ECCENTRIC HOLE
FIG. 2. A UNIVERSAL BELL CHUCK

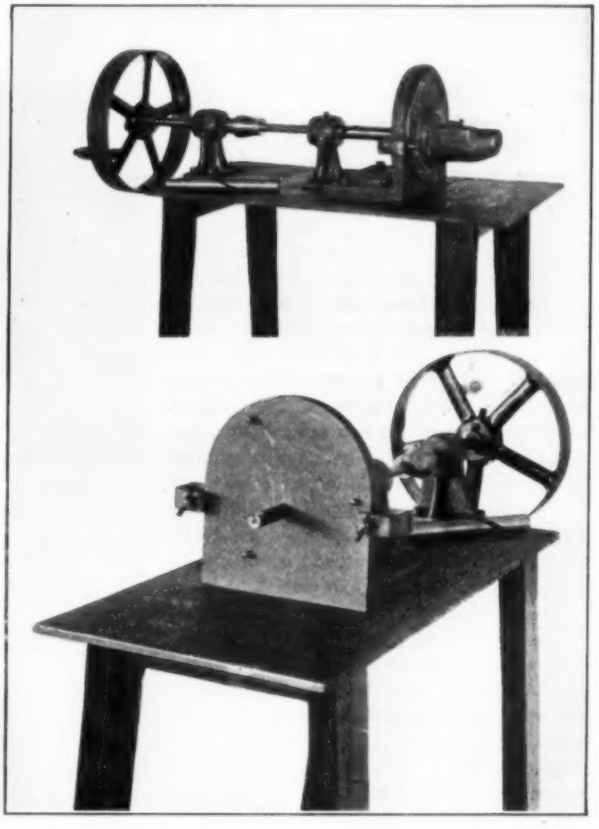


FIG. 3. CUTTING SPIRAL OIL GROOVES

Balancing Threshing Machine Cylinders

A Difficult Piece of Work Requiring Much Skill and in Which a Knowledge of Principles Has Little to Do With the Results Obtained

EDITORIAL CORRESPONDENCE

Probably few of our readers are aware that the original shop to bear the name of Westinghouse is located at Schenectady, N. Y., the corporation's title being The Westinghouse Company. This shop was founded by the father of George Westinghouse in 1836. One of its leading specialties from the start was, and still is, agricultural machinery, including threshing machines. The cylinders of these machines run at a high rate of speed—1100 to 1300 revolutions per minute—and they are complex structures made up, except for the shaft, of rough stock. Their support is, of course, the box-like threshing-machine case, which, in turn, is carried upon wheels for purposes of transportation, giving a support which is anything but firm, and which necessitates an accurate running balance of a roughly made, complex member. The length of the cylinders is such as to make it easily possible for them to be unbalanced when running, although balanced when standing still, and Mr. Westinghouse early introduced the method of balancing these cylinders which is described below, and which was at that time a new departure, the regular practice then being to give such cylinders a standing balance only.

The reader will see that the methods used have little application to other work, but no more interesting operation has ever come under my eye, and I believe its publication is justified from the standpoint of interest alone.

The Balancing Problem

The complete problem of balancing the rotating parts of high-speed machinery is by no means a simple one. In addition to the fact that revolving parts, if of considerable length, may be, and often are, in standing without being in running balance, is the question of the flexibility of the supporting shaft. Under ordinary conditions as regards the stiffness of the shaft, the high side of a revolving piece is the same as the heavy side, but if the shaft is sufficiently flexible and the speed is sufficiently high, this condition is reversed and the high side is opposite the heavy side. This last condition is illustrated by the boy's toy, a revolving disk of tin strung on a twisted string held between the thumbs, in which the supporting string has substantially no lateral stiffness and in which instinct tells us that the rotation will be about the center of gravity of the disk, the high side being the light side.

So far as I am aware this condition never appeared in actual machinery until the advent of the De Laval steam turbine in which the shaft is purposely made flexible in order that the revolving member may rotate about its center of gravity instead of, as usual, about its geometrical center.

While it is necessary to include this condition in any complete discussion of the balancing problem, it may be omitted in all ordinary cases in which the shaft has sufficient stiffness to insure the high side being the heavy side of the revolving piece. The only point needing discussion in order to make clear the putting of ordinary machine parts in running balance is that out of which grows the fact that such balance does not necessarily exist although the parts may be in perfect standing balance.

The Principle of Running Balance

Fig. 1 shows two balls *a* and *b* mounted on arms extended from a revolving shaft, the balls being of equal weight and the arms of equal weight and length, under which circumstances it is obvious that the system as a whole will be in perfect standing balance. If revolved at high speed, however, a centrifugal force *a c* will be generated in the ball *a* and a corresponding centrifugal force *b d* in the ball *b*, and as these forces are not in line with one another, the net result as the piece revolves is a revolving couple which gives rise to vibration of the shaft.

The correction of this condition of affairs is simple enough in principle and requires nothing more than the addition of two counterbalance pieces *e* and *f*, equal in weight and radial distance to *a* and *b*, or of less weight and greater radial distance, or *vice versa*, such that the centrifugal force of the added pieces balances that of the original balls, respectively, and it is, moreover, obvious that the addition of these balancing pieces will not disturb the standing balance of the system.

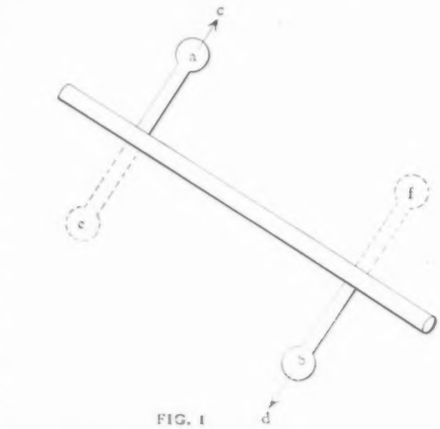


FIG. 1

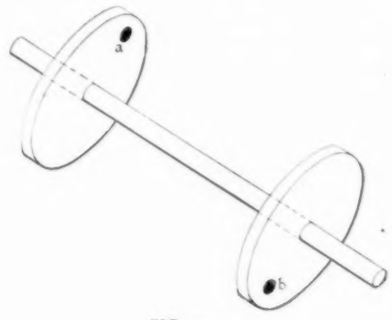


FIG. 2

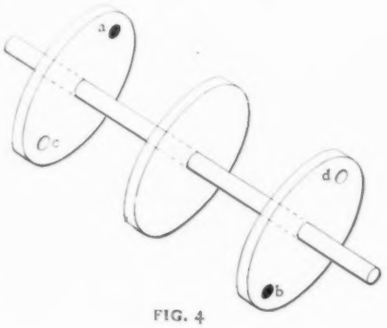


FIG. 4

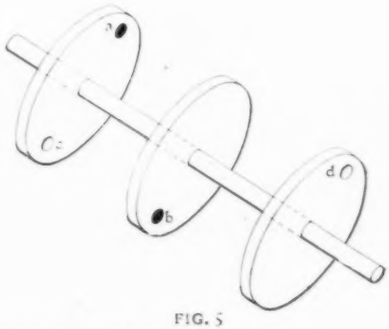


FIG. 5

THE PRINCIPLE OF RUNNING BALANCE

In actual revolving pieces which have been placed in standing balance we do not have plainly visible weights like the balls *a* and *b*, of Fig. 1, but instead we have the fact that metals are not perfectly homogeneous. For example, two disks upon a shaft as in Fig. 2, although in perfect standing balance, may have heavy spots located at *a* and *b*, which will obviously act precisely like the balls of Fig. 1, the placing of the system in running balance involving the addition of

counterweights opposite the heavy spots precisely like the counterweights of Fig. 1.

The difficulty of the problem lies in the fact that no test to which the parts can be subjected when at rest, on parallel strips for example, will give any indication of the position or weight of the heavy spots, nor is it, I believe, possible to determine them by any known means. The placing of the parts in running balance consists of finding the positions and weights of the counterweights which destroy the vibrations and between the weights and positions of these counterweights there may be an indefinite number of combinations, any one of which gives little indication of the positions and weights of the disturbing heavy spots.

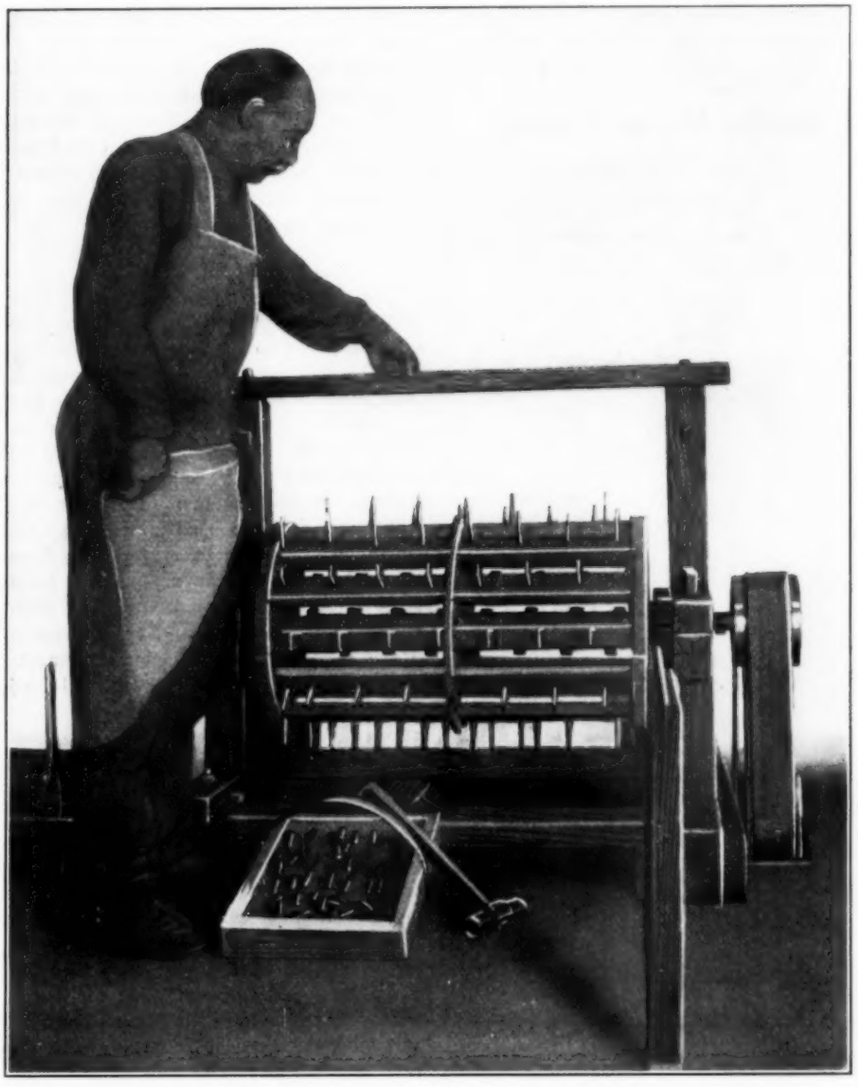


FIG. 3. THRESHING-MACHINE CYLINDER IN THE BALANCING FRAME

The Forces Developed are not Small

The reader should not get the impression that the disturbing forces set up in revolving parts which are in standing balance are necessarily small. On the contrary, parts which are in standing balance may, and frequently do, develop violent vibrations at high speed. This is due to the fact that the centrifugal force of a revolving mass at a radius of one foot from the center of motion becomes equal to the weight of the mass at the low speed of 54 revolutions per minute, from which point it increases as the square of the number of revolutions. Small heavy spots may thus develop large forces at speeds which are common in machines.

A Threshing-machine Cylinder

Fig. 3 illustrates a threshing-machine cylinder for which the photograph has been supplied by the courtesy of the Westinghouse Company. The cylinder is mounted in the frame in which it is balanced and the illustration will also serve as a means of describing the construction. The cylinder consists of three cast-iron disks keyed to a shaft and having a series of pockets around their circumference. In these pockets are placed bars of wood, which are inclosed except for their interior surfaces, by rolled-steel bars of U-section over which are shrunk rings of horse-shoe iron to confine them in place. Through a series of holes in the bars the spikes which beat the grain from the chaff are inserted, nuts being placed on the inner ends and screwed up against the exposed sides of the wood bars—the object of the wood bars being to provide an elastic seat for the nuts and thus secure them from getting loose. The ends of the wood bars are exposed at the ends of the cylinder where they come flush with the outside of the disks and form a convenient place into which to drive short stub spikes of varying weights by which the final balancing is accomplished.

The bars and spikes are of rough steel, the cast-iron disks being also rough, a fact which complicates the distribution of the disturbing forces, but two extreme possible conditions may be understood by disregarding the bars and considering the case of a shaft having three disks upon it, the whole system being in both cases understood to be in standing balance but with differently distributed heavy spots.

Two Extreme Conditions

The first extreme condition is shown in Fig. 4 in which the central disk is supposed to be in balance while the outer disks have each a heavy spot located at *a* and *b*. This case is analogous to the one shown in Fig. 1 and to effect a perfect running balance it is only necessary to attach equal weights at *c* and *d* such as to compensate the disturbing action of the heavy spots.

It may easily happen, and in fact it frequently does happen, that one of the heavy spots *a* or *b* is due to the weight added in the preliminary balancing for standing balance, and in that case running balance may be accomplished by dividing the weight *b*, for example, in halves, removing one-half of it to *c*, and then attaching at *d* an additional weight equal to what is left at *b*.

The second extreme case is shown in Fig. 5, in which the disk at the right is supposed to be in perfect balance by itself, the disturbing heavy spots being located in the central and left-hand disks at the points marked *a* and *b* as before.

In this case balancing might be accomplished by placing opposing and equal weights opposite *a* and *b* as before, but in the construction of the threshing-machine cylinders the middle disk is not available for this purpose, the construction being such that the final balancing weights can be attached only at the extreme ends of the cylinder. In this case, then, the final counterbalance weights are attached at *c* and *d*, but their weights are now less than those of the disturbing spots. In the arrangement shown, with the middle disk exactly at the center of the shaft, the weights *c* and *d* would have one-half the weight of the disturbing spots, the increased distance between *c* and *d* measured lengthwise of the shaft compensating for the reduced weight.

Balancing a Cylinder

The principle concerned being thus

clear, the operation of balancing a cylinder may be explained. It is first placed on parallel strips and a standing balance given it by attaching weights, of which an assortment is provided, to the interior of the end disks under their flanges. This operation completed, the cylinders are run in the frame shown in Fig. 3 which, although firmly made, is obviously subject to vibration. In the tray shown in the foreground is an assortment of short stub spikes or slugs of varying weight and suitable for driving into the exposed ends of the wood bars, these spikes being the final adjusting weights. The cylinder being speeded up, the workman runs his hand along the rail at the top as shown, and from its vibration he forms an idea of the nature of the disturbing heavy spots. If the vibration is substantially uniform at both ends the condition of things approximates that sketched in Fig. 4, while if one end vibrates more than the other, the condition approaches that given in Fig. 5. Stopping the cylinder he drives in a pair of spikes of equal weight, one in each end of the cylinder and diametrically opposite each other. This first operation is purely a blind one and after the spikes are in place the cylinder is again speeded up and the rail is felt as before. If the vibrations are now worse than before the first spikes are, of course, all wrong and a fresh first trial must be made, whereas if the vibrations are smaller than before they give a first approximation of what is required, although the result may be a remaining underbalance or an overbalance due to the spikes being too heavy. In this way by repeated trials the weight and positions of the spikes are determined, and when the balance is completed the spikes are driven home and the work is done.

It should be added that the work is progressive; the cylinders being first balanced at 800 revolutions per minute and then at 1000 and 1200 revolutions per minute.

The Skill Required

I shall not attempt to describe in detail just how all of the various kinds of shakes to which that bar is subject are interpreted by the workman, because I do not know. The work is one requiring a high degree of skill and as an onlooker sees it done he has the feeling come over him that here is something that he could not do. The final result is due to skill and not knowledge, as no amount of study of the principles involved will enable one to do the work.

The interpretation of the shakes of the bar, with the resulting placing of the spikes without any reason apparent to the onlooker, but with steady improvement in the behavior of the cylinder is, in fact, more like a piece of shop wizardry than I have ever seen.

Until his recent death the work had been done at the Westinghouse works by an old gentleman whose special job it had been for a period of over 30 years. I do not imagine that he could have given any explanaton of his actions nor, indeed, that he had the slightest idea of the principles involved. The clearer the understanding of these principles and of the obscurity of the indications which were his only guide, the more one feels like taking off his hat at the results.

In the hands of a skilled man the balancing of a cylinder requires from half an hour to an hour. In the hands of an unskilled man the time and the results are purely maters of luck with the probabilities against any acceptable result.

F. A. H.

Bending Moment Diagram

By E. H. Fish

In the study of beams and girders graphic methods may be made to serve a very useful purpose, especially if they are mixed with a little of the analytical. Assuming that the reader is familiar with the straight-line diagrams for concentrated loads, and the parabola for uniformly distributed loads we will consider the effect of mixed loads. To give us a standing basis, I suggest the following rule:

A concentrated load equal to the whole of a uniformly distributed load may be substituted for the latter; a bending-moment diagram may be drawn for the concentrated loads and then a parabola may be drawn tangent to this bending-moment diagram opposite the distributed load. The result will be the bending-moment diagram for the original load.

To illustrate the rule take Fig. 1, a cantilever with a distributed load from *a* to *b*. Substitute a concentrated load $w\,d$ for the distributed load and draw a bending-moment diagram for it as in Fig. 2; the maximum moment is

$$w\,d\left(c+\frac{d}{2}\right).$$

The maximum will be 0 under the concentrated load and to the right. To convert this diagram into one for the original load draw a parabola tangent to $a\,e$ and $a\,x$ between c and d; $e\,c\,d\,x$ is the required curve. The bending moment at any distance from the support is found by scaling the hight above $O\,x$ with the same scale that was used in drawing $O\,E$.

In combining diagrams for both concentrated and distributed loads a point must be carefully noted which is illustrated in Figs. 3 and 4. The diagram is drawn by computing the bending moments at the wall, under the concentrated load *and at the centers* of the two parts of the uniform load each side of P. The ordinates are plotted, as in Fig. 4, to any convenient scale and then parabolas are drawn tangent to $c\,d$ and $d\,e$ at c and e, and tangent to $e\,f$ and $f\,g$ at e and g. The two parabolas are not parts of one curve, but constitute two entirely separate curves making an angle with each other at e. In the case of beams having two supports, the same principles apply as to the substitution of concentrated loads for distributed; the drawing of moment diagrams and later the drawing of tangents to the first diagram over the part of the beam which carries the uniform load. Fig. 6 represents such a load and Fig. 5 represents a corresponding moment diagram. A parabola is drawn between the points e and f under the ends of the load. If the load had been continuous from the left-hand end of the beam over to f then the parabola would have been tangent to the straight lines at o and f; if the uniform load had extended over the whole length the parabola would have extended from o to x, but tangent to the same two lines.

Combined uniform and concentrated loads may be treated as in Figs. 7 and 8. Substitute P_1 and P_2 for the uniform loads

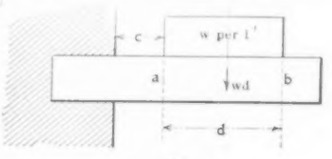


FIG. 1

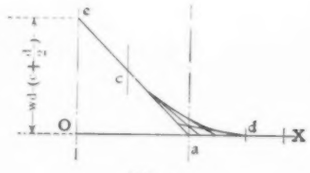


FIG. 2

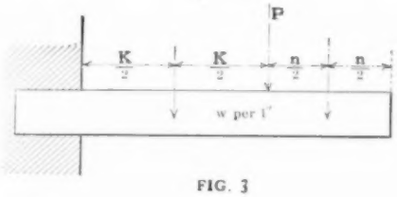


FIG. 3

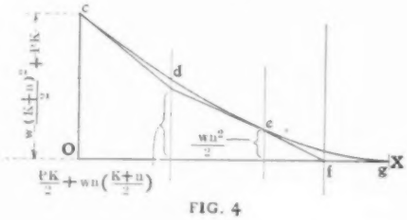


FIG. 4

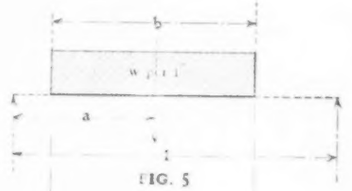


FIG. 5

FIG. 6

BENDING MOMENT DIAGRAMS

at their centers and draw the straight-line diagram of Fig. 8. Then draw tangent parabolas from *o* to *b* and *b* to *d*, under the loads. The same method applies no matter how many different loads may be found.

Loads Between and Outside of Supports

Fig. 9 shows a beam projecting over one support with two concentrated loads of 1000 pounds each and a uniform load of 1000 pounds per foot on the left-hand end, and one of 500 pounds per foot over to half way out on the cantilever. It is easier in a case with several loads like this to take numerical values rather than letters. We first substitute for the load between *a* and *b* its amount 4000 pounds concentrated at its center, Fig. 10, and for the load between *b* and *c* its amount 3000 pounds at its center and do the same

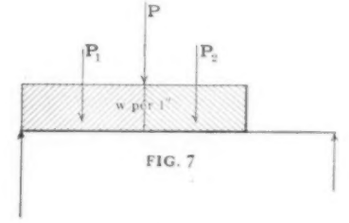


FIG. 7

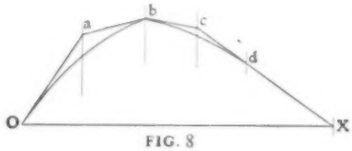


FIG. 8

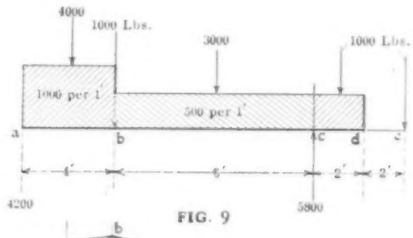


FIG. 9

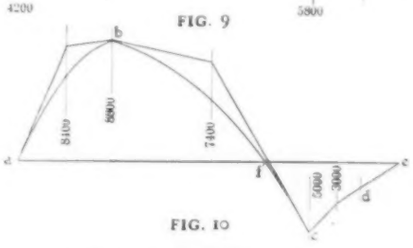


FIG. 10

BENDING MOMENT DIAGRAMS

with the load between *c* and *d*. We then draw the straight-line diagram of Fig. 10, bearing in mind that at or under *c* and *d* the tendency of the forces is to break the beam by bending it in the opposite way from that in which the forces to the left tend. Then we must draw parabolas tangent to the straight lines, opposite the different uniform loads as from *a* to *b*, *b* to *c* and *c* to *d*, Fig. 10, computing the bending-moment curve. Note that point *f* is the point of no bending moment, or what is known as the point of inflection, since if there is no bending at that point in the beam there is a change in the direction of its curvature at that point.

The Use of Diagrams

The diagrams are valuable, primarily, in discovering the position and amount of the maximum bending moment which a given beam may have to carry. If a uniform beam, for example, a rolled section, is to be used all that is required is to find the points of zero shear and then if it is not evident which point has the largest numerical value for its bending moment, compute the bending moments at all points where the shear is zero. Then it is simply a case of selecting from the tables in Carnegie or Cambria what beam is needed. On the other hand, in case a beam is required to carry considerable loads, as a built-up beam, it is possible to discover by aid of these diagrams where a considerable saving in weight and expense may be made. Figs. 11, 12 and 13 show a case of this kind where it is desired to carry the loads shown by means of a 24-inch light I-beam by aid of reinforcing plates, top and bottom, each 8 inches wide and ⅜ inch thick.

Under a fiber stress of 15,000 pounds per square inch and with no present allowance for rivet holes the I-beam itself will carry a bending moment of 217,500 foot-pounds. With one plate ⅜ inch thick top and bottom it will carry 300,875; with two plates 385,000, and with three plates 486,750 foot-pounds.

Draw Fig. 12 a bending-moment diagram to scale as in the previous problem. This figure also carries lines *g*, *h*, *k* and *l*, representing the moments which the I-beam will carry and the moments which it will carry with one, two and three plates top and bottom. Between the supports the bending-moment diagram shows the required moment to exceed that which is safe for the I-beam alone from *m* to *n*, Fig. 13, and from *o* to *p* it slightly exceeds the safe moment when one plate is

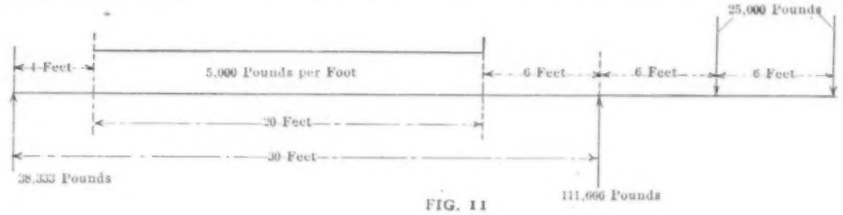


FIG. 11

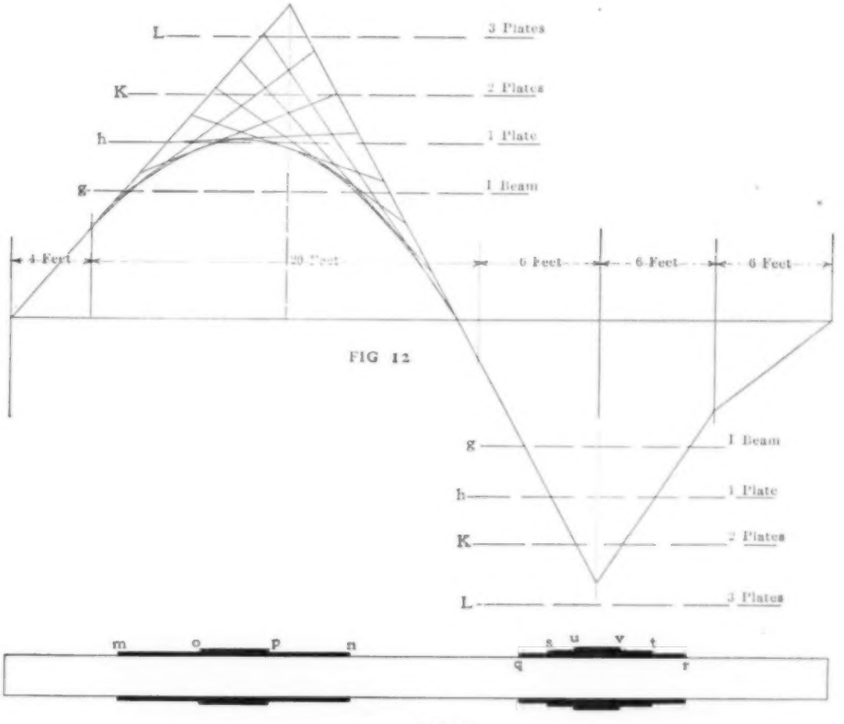


FIG 12

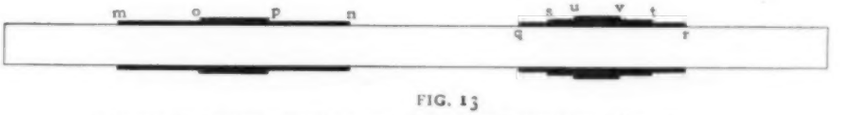


FIG. 13

BENDING MOMENT DIAGRAMS OF A 24-INCH REINFORCED I-BEAM

used, hence use plates as indicated in Fig. 13. Over the right-hand support from *q* to *r* one plate is needed, from *s* to *t* two plates and from *u* to *v* all three plates, showing that all three plates are needed over only a very small part of the whole length and that a considerable saving may be effected by only using plates where needed. In actual construction these plates should be made at least enough longer than the diagram indicates to get in one extra rivet at each end and after the riveting has been determined the strength of the sections should be recomputed.

The Alinement of New and Realinement of Old Shafting

By James Lomas

While discussing the above subject with a friend of exceptional experience, he ventured the astounding remark that it would be impossible to find a line of shafting in any mill or works in approximately true alinement. There is undoubtedly much truth in his statement.

The importance of shafting being correct in its position, that is, level in its bearings and in a perfectly straight line sideway the whole length, cannot be overestimated. Those persons of experience who have had to deal with the faults and follies of incorrect and badly executed work, know well the extra cost of maintenance requisite to keep a mill or works in constant operation; overtime for the engineer in charge; occasional stoppage of the machinery through needless friction in the bearings; wheels, pulleys and couplings loosening daily, and breaking; extra cost of fuel and labor in the fire room; extra wear and tear of the engines, etc. These are only some of the troubles attributable to shafting not in true alinement!

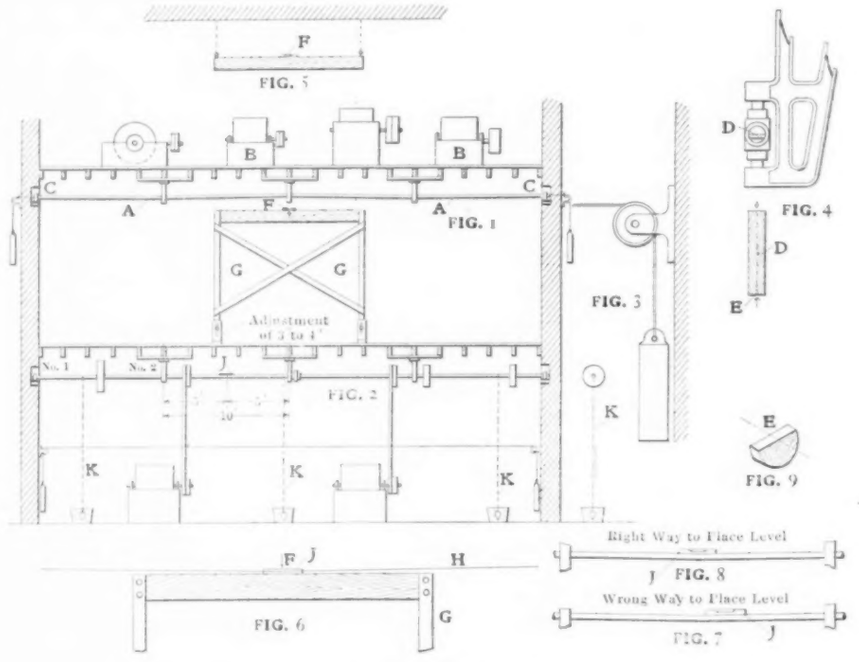
The causes of all these troubles are manifold. On new work the system of erecting generally carried out is unquestionably faulty; and such faults may arise from many sources; such as the settling of the foundations of the building, the warping or twisting of the floors where wood beams have been used, the distortion in structural steel and iron work, and where fireproof floors are constructed either in brick, concrete or similar material and the shafting is erected before the floors are thoroughly set and dry (and this usually takes a considerable length of time) the result of the millwright's labor will be unsatisfactory. As soon as a mill or workshop building is sufficiently advanced in its construction to enable the millwright to fix the hangers or brackets he is generally told to do so. Often this occurs before the windows are in their places. The reason for doing this is because there is much to be saved in cost of erection. The room is clear of obstructions and this simplifies the work very much; scaffolding is often at hand and there are many other conveniences which help the work forward. This method, of course, suits the workman, the contractor and the owner, and on first sight appears strictly economical, as it gives a quickly executed and a cheap job. But after giving the matter fair consideration it will be found readily to be false economy and an increasing extra expenditure will be requisite until the work is remedied. To illustrate this I refer the reader to Fig. 1, *A A* showing a line of shafting attached underneath a floor, where a quantity of heavy machinery is installed above. The weight of the machinery has distorted the floor; the shafting, of course, is out of alinement no matter how carefully the work was done before the heavy machinery was placed in position.

The same thing occurs if a line of shafting is carried on a ground floor through floor stands or pillow blocks, as the floor or foundations are almost sure to settle. Luckily, the remedy is simple if those who are responsible can be led to see it. The logical system to adopt is to let the mill be finished and the shafting erected before the machinery is fixed. Then a short time before the machinery is put in operation to realine the shafting and make all the bolts, etc., secure; thus will be seen clearly the advantages of this method over the first-named, as the shafting is much more likely to run under better conditions and for a longer period without attention except the usual oiling and cleaning, etc.

Of course, many people will be tempted to think this system entails a lot of unnecessary labor, but if they will reason the matter out and place the work in skilled hands, I venture to say they will be well satisfied with the result as they will unmistakably save money.

Let anyone take the trouble to test a line of shafting erected under the first-named conditions, when the shafting has been at work three months, and he will require no further confirmation that the system is entirely wrong. However, under any circumstances it is necessary to have a second alinement to obtain the best results, and if strict economy is to be considered a periodical alinement should be made, say, every 12 months. Of course, the bearings should be under constant examination.

If the reader will study the method of the realinement of old shafting shown in Fig. 2-J its simplicity will be apparent, and the cost of putting mill shafting in order will be a mere fraction compared to the advantage gained. Let mill owners think for one moment of the continual loss occurring through the defective condition of their mill shafting, that has probably been working for years without any attention further than the usual oiling. So long as the motive power is sufficient to move the shafting round it is not considered necessary to do anything more until suddenly there is a smash and everything is stopped, sometimes for days. Yet to remedy all this is such an extremely simple matter to the practical man as will be seen by again referring to Fig. 2-J and the benefits to be derived therefrom need not be further commented on. The work of realining can be done when the mill is stopped for holiday or at a week-end, and little or no inconvenience need be suffered by anyone. I have undertaken many such jobs and in no case has it taken more than two week-ends to complete a fairly large job. It has been found that the shafting has been frequently out of level from ½ inch to 2 inches. In one case, that of a new mill with the shafting erected by one of the best known firms in the country, the said shafts were 2½ inches diameter and the distortion was owing to the steel beams that the hangers were attached to and which were embedded in a fireproof ceiling; the floor above was covered with heavy machinery. The irregular torsional strain on the shafting was the cause of about a dozen ends of shafts twisting off



DEVICES FOR ALINING SHAFTING

and the split muff couplings were constantly coming loose. This went on until the whole of the shafting had been realined, although the mill had not been at work more than 12 months.

Where the shafting is carried in adjustable bearings the leveling is a simple matter, but where non-adjustable fittings are in use the work is much more difficult, still not so much so but that intelligent workmen can deal with it. The best line to use for the purpose is piano wire which, when used as shown in Fig. 3 gives very little deflection or sag. The next best is the strongest line procurable, but fairly fine.

How to Erect and Aline Shafting

Having determined the position and type of hanger, wall bracket, pillar bracket or pillow block to be used, fit the two end bearings in position. Next secure the line as short a distance as possible beyond the end of each bearing. The usual method of so doing is by driving a spike into the wall or other convenient place. The line is carried through the end bearings, pulled taut and made secure. This method is very unsatisfactory, inasmuch as from various reasons considerable deflection or sag occurs, consequently the line requires to be repeatedly tightened. A much better method is shown in Fig. 3; a bracket with pulley is fixed at each end of the shaft line and the line placed through the end bearings. A weight is fastened to each end of the line, see Figs. 1 and 2. Thus the line is kept taut without further trouble.

At this stage it will be necessary to get the line level from end to end, having placed in each end bearing a strip or float, made as per Fig. 4, and secured the bearings so as to hold the strip firm with the central line marked *E* on the strip parallel to the line (cord or wire) that the rest of the bearings are to be fixed by. Then proceed to fix the straight edge, the center of which must be exactly at half distance between the end bearings. This point is very important, for if placed at an unequal distance between the end bearings, the deflection of the cord will mislead the erector. The straight edge may be carried by a cord attached to each end and hung from ceiling; see Fig. 5-*F* or a temporary frame made as per Fig. 6-*F*, whichever is the most convenient under the circumstances. Having carefully leveled the straight edge, adjust the two fixed hangers so that the cord will be parallel to the straight edge. Then, having made that secure, notice the deflection in the cord *H*, Fig. 6, and a simple calculation will show the relative position of the central hanger.

Next, fix the central hanger, making allowance for the deflection of the cord line; having made this secure place a wood center as per Fig. 9-*E* in the middle of this center bearing to support the cord line. There will then be very little deflection on the cord line in the intermediate distance between the central and end hangers. The rest of the hangers can then be fixed in position and made secure. Having fixed such hangers in position the shafting can then be placed in the bearings, the couplings fixed in their position and made good, having made everything all right by fixing the caps on the bearings, etc. The shaft may be revolved to insure it being properly placed in the bearings before the leveling is done. The spirit level *J* should be a reliable make 18 inches to 2 feet long, and adjustable. When using it on the shaft it should be exactly central between the bearings as there will be some deflection in the shaft, and if tested on one side of the center between the bearings the erector will be misled. See Figs. 7 and 8-*J*.

If the work has been carefully carried out up to this stage, it will be found that very little adjustment will be necessary. The next thing is to test it sideways, and having finished with the cord line on the shaft level, refix it at a convenient distance from the floor, say 3 or 4 feet. But first, drop a cord line from each end of shaft with a heavy plumb bob or weight attached and let the latter hang in a pail of water. See Fig. 2-*K*. This insures steadiness of the plumb line. Then carry the cross line, Fig. 3, the whole length of the shaft and adjust it so as to be about 1/64 inch clear of the dropped line at each end. Then by dropping a plumb line from each bearing as shown in Fig. 2-*K* beginning at No. 1 and testing one at a time with the same plumb line until the whole number have been tested.

To realine a shaft where the place is filled with machinery it is necessary only to carry out the aforenamed instructions, excepting that a scaffold or other convenience may be required above the machinery. In erecting non-adjustable hangers on brackets, the adjustment is obtained by using wood or other packing pieces between the base of the bracket and the beam, making the work much more difficult. Yet, the instructions given above, generally are applicable, except that each bracket or hanger should be leveled by resting the straight edge in the previous one and spanning the two, beginning at No. 1 and proceeding to the end. The straight edge should not be less than 12 feet long, 10 to 12 inches wide and 1¼ or 1½ inches thick, and the two edges will be exactly parallel.

Considerable has been published of late in connection with the two new German soldering compounds "Tinol" and "Fludor," and it is useful to note from comment on the subject in the *Elektrotechnische Zeitschrift* that from a thorough investigation it was obtained that "Tinol" consists of 7.9 per cent. glycerin, 3.1 per cent. ammonium chloride (salammoniac) and 88.9 per cent. metallic powder. The metallic powder contains equal parts of tin and lead, having consequently the composition of a soft solder.

Where the Bonus System Falls Down

By R. E. Marks

Did you ever notice how willing, or even anxious we are to save money when the other fellow takes all the risk and how, after he really gets to the saving point, the "savee," to adopt the terms of the law sharps, wants to renig when the "saver" begins to make a little money out of the deal? If you haven't, you just watch the next case you know, or better yet, try it on yourself. Here's what happened to my friend Bill—no matter what. or where.

Bill had worked all over the earth and Canada, had run shops that made hair-pin machinery, and from that to locomotives, but he had got tired of wandering and took a job to rejuvenate a corpse at the shape of a shop that was building sausage stuffers. Not a very poetic business, but a good sausage stuffer was better than a poor milling machine and he undertook to make good.

They offered him a fair salary to start with and a very comfortable boost at the end of the first year, so Bill thought he was fixed and began to enjoy life once more.

He had one advantage over some shops, anything he did was an improvement—perhaps you've seen that kind. When Bill started in the nearest approach to a jig was a manilla paper templet for the holes in a pipe flange, so it couldn't be said he had no opportunity.

Things went along very comfortably until it came time for the aforesaid boost to materialize in the pay envelop, when the money sharp got busy in the office. So he fudged up a counter-proposition which put it up to Bill to make good. Instead of the boost, which meant a steady drag on the bank account, as well as a tension on the pocketbook nerve, the plan was to continue the old salary, but give Bill a percentage of all his savings on labor cost.

'Twas fair enough, so Bill signed upon the new deal and dug in harder than ever because every dig meant a few cents in Bill's pockets and there's nothing like a little of the coin of the realm to make anyone hump his prettiest.

Bill kept plugging along, getting his old-time fatness in the pay envelop and occasionally making a few figures to see how his percentage was coming along. As I said before he had every chance in the world and he didn't pass up very many of them either, so it didn't take long to show him that the new deal was a winner and that he was better off than before. Then too, it showed the firm just how much he was saving them over the previous cost of the same work so that they would be happier the more he made.

At least so it seemed to Bill.

But there seems to be a peculiar twist in the think tanks of some of these money sharps. They think in percentage as long as it is squeezing discounts off the bill of some poor chap that needs the money to pay his rent, but they only see total amounts when it comes to the pay roll. This financier had the same disease.

He began figuring up what Bill would be likely to get during a good year, when hogs waxed fat and the eaters of sausage had the price thereof. And the result staggered him. He could see nothing but totals and these were so large that they were entirely out of the question for any greasy mechanic. 'Twould surely go to his head and might be his ruination. And they would be responsible, perish the thought.

So, instead of renewing the contract on their own basis, they wanted to go back to the old deal, jumping the salary to the highest point before named, but cutting out the percentage game forever after. Then Bill hunted another job.

This is just another case of seeing labor cost in chunks without looking at the results. Twas a four to one division. That is, for every dollar Bill saved he got twenty cents, and they got four times as much, or eighty cents. And you'd almost think even a financier could be happy when he was getting eighty dollars clear money—velvet—and only giving up twenty to the fellow who got it for him.

If he lost a hundred he'd be glad enough to give twenty for its return and no questions asked, but here was a hundred that he'd never even had in his hands, and he wanted it all. Couldn't bear to see Bill get even a twenty, although he admitted it was all due to his efforts. Couldn't see that for every dollar Bill got, the firm had four dollars of real cash, just like getting money from home. Couldn't see that besides all this they had increased the output of the shop a whole lot of per cents. without spending a dollar for new tools, for buildings, for taxes, or for anything but labor.

And yet he wasn't any different from a little million others who are in the same position. All the savings in the world are lost sight of if Bill, or anyone else, can save enough so that his share mounts up beyond what a shop man ought to get, according to the office rules. And it doesn't make much difference whether it's a contract for piece work on a bolt cutter, or a bonus for the superintendent, the average manager won't stand for too much of a saving by either one when he gets a whack out of the money he has saved.

It is interesting to note that in connection with the conservation of water power a recent advance in transmission voltage, by the placing in service of a 110,000-volt line in Michigan, is a clear indication of the rapid elimination of distance as an obstacle to electric-current service.

Device for Testing Precision Levels

By W. Pockrandt

The precision levels that can be purchased in the market do not correspond to the fullest extent with the claims of accuracy that are made for them. This quality of precision is one that is required in a machine shop where the instrument is used to inspect machine tools. Further, the levels either multiply to too great an extent or they are over-sensitive and thus in the shop their bubbles are always vibrating and do not come to a position of rest. It is therefore wise to prove the accuracy of a level before one uses it for work of testing.

This purpose is served by the device shown in Fig. 1 as used in the practice of the testing department of Ludwig Loewe & Company, Actiengesellschaft, Berlin, Germany. The device consists of an iron straight-edge with an accurately leveled and carefully scraped surface. Upon this the level to be tested is placed. To prevent the warping of this accurate surface, the straight-edge is stiffened by one longitudinal and several cross ribs. The straight-edge rests upon two securely fastened supports extending upward from a common base plate. One of these supports is provided on its upper surface with a knife edge upon which rests one end of the straight-edge, while upon the other support is arranged a micrometer screw by means of which the straight-edge can be raised and lowered. The distance from the knife edge to the center of the micrometer screw measures exactly 1000 millimeters. The turning of the micrometer screw for one division of the scale brings about an inclined position of the straight-edge of a hundredth part of a millimeter in 1000 millimeters of length. The base plate of the device is shown with two leveling screws so that one can also set the finished surface of the straight-edge level in a cross-wise direction. The firm of Ludwig Loewe & Company uses this device to test whether or not the air bubble moves accurately throughout the leveling distance and to determine its middle position, or how many divisions it is out toward either side.

Further, it determines what inclination expressed in hundredth parts of a millimeter per 1000 millimeters of length, a division of the level indicates. This is then marked upon the level, because such a method is more important for the machine shop than a design that expresses a division in French lines, or minutes and seconds, as one finds on ordinary instruments. If now, a workman finds from the level, say a movement of the air bubble of one division corresponding to an inclination of 1/10 millimeter per 1000 millimeters of the length, he can therefrom very easily determine the inclination for any other length whatever; while a calculation from the square is not necessary.

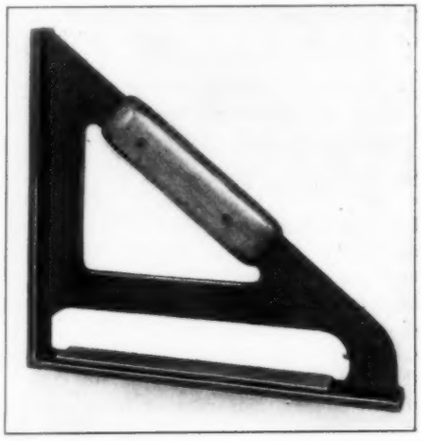


FIG. 2. A SQUARE ARRANGED TO USE WITH A LEVEL

The level can also be used profitably under one leg of a square to test perpendicular surfaces. Such combination instruments, especially adapted for this purpose, are purchasable in the markets. If level and square are not fastened together, the square has an accurate straight surface on which the level can be set in any desired position, see Fig. 2. This type of instrument has this advantage: In many places the level, even without the square, is troublesome and is an unhandy instrument and anyone can, therefore, adjust and use it in the manner desired much better than if it is combined with a square.

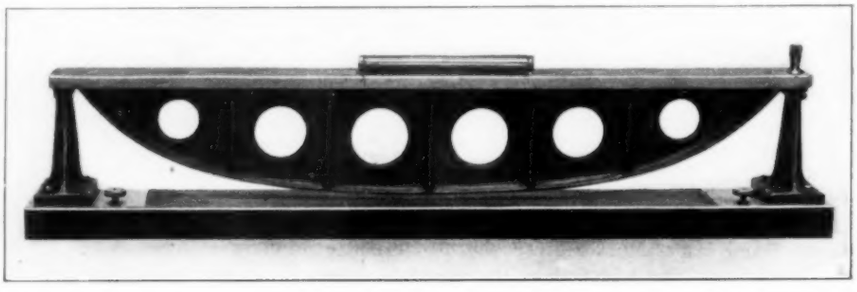


FIG. 1. DEVICE FOR TESTING PRECISION LEVELS

Details of the Mitchell Planer Drive

Idle Pulleys, a Slipping Clutch and Air or Electric Operating Mechanism Produce a Drive Whereby Planers Can Be Speeded up

BY FRANK SAWFORD

The planer drive described in the following article was designed for the purpose of enabling large powers to be applied to planers, or any other class of reversing machinery, and at the same time to allow of easy and sensitive operation. The difficulties of driving large planers with the ordinary shifting belts are well known, and it has been usual to drive the larger sizes of planers by means of clutches operated by electric or pneumatic power. The device herein described is a belt drive, but differs from the shifting-belt drive mentioned above, in that any width of belt may be used, and the belt speed may also be kept as low as desired; consequently any amount of power may be delivered to the planer.

This device was designed by W. C. Mitchell and was first applied to a 14-foot planer* to replace a set of magnetic clutches with which this planer was formerly equipped. It proved so much superior to the magnetic clutches and was so successful in operation that this form of drive was immediately applied to a number of other planers ranging in size from 5 to 10 feet, displacing both magnetic clutches and shifting belt drivers. The cutting and return speeds of these planers were also increased; the cutting speed being only limited by the character of steel used for cutting tools. In one instance a 7-foot planer was operated at 75 feet per minute on the cutting stroke without the slightest shock or jar to the machine. This cutting speed, however, was found to be too high for the tools to stand satisfactorily and was reduced to 50 feet per minute; the return speed was maintained at 150 feet per minute.

The use of the Mitchell drive has since been extended to other planers, both in England and different parts of Europe, and up to the present time over 60 planers are in daily operation with this device, and 150 feet per minute on the return,

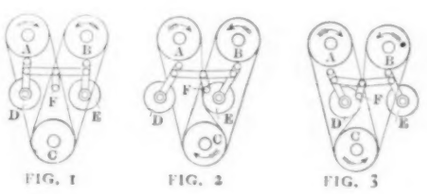


FIG. 1 FIG. 2 FIG. 3

DIAGRAMMATIC VIEWS SHOWING BELTS AND PULLEYS ON A MITCHELL REVERSING DRIVE

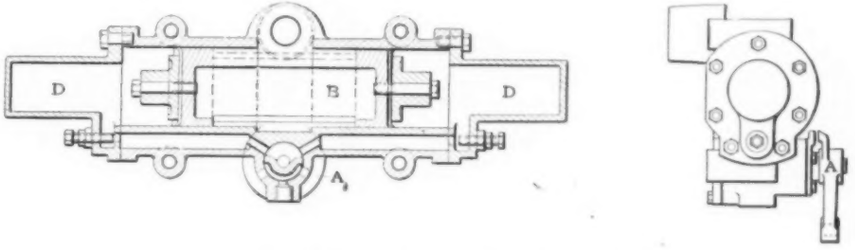


FIG. 5. ARRANGEMENT OF CYLINDERS AND AIR COCK

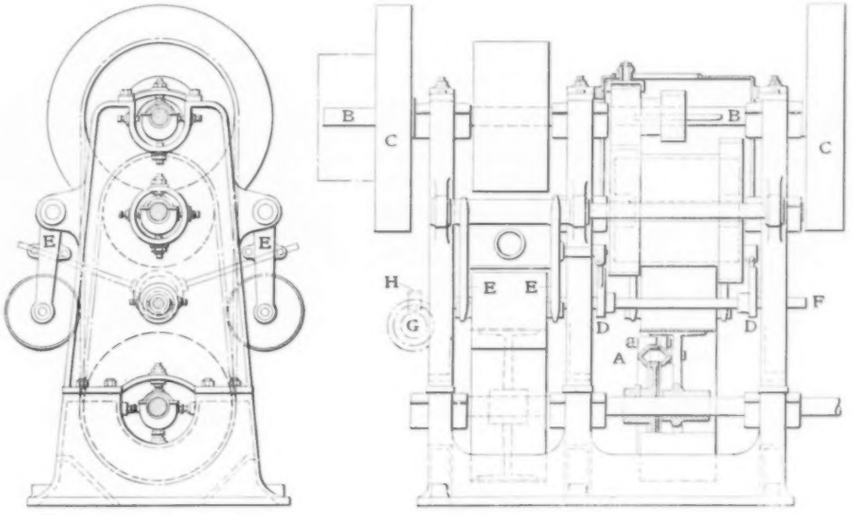


FIG. 4. ARRANGEMENT OF A COMPLETE MITCHELL DRIVE

Applied to a Blooming Mill

The drive has also been applied recently to the table rolls of a 36-inch blooming mill with perfect success; displacing two reversing steam engines. In this instance an 85-horsepower constant-speed induction motor is used to drive the table, and it is believed that this is the only instance of a blooming-mill table being driven by such a motor. Those who are familiar with steel plants will readily understand how severe this class of work is, and electrical men in particular will appreciate the obvious advantage of the above arrangement.

Principles of the Drive

The drive is very simple and is briefly a method of running two loosely hung belts in opposite directions. Each belt is run at whatever speed is desired and is alternately tightened by means of a jockey pulley. Both driven pulleys are keyed to the same shaft; the direction of rotation of this shaft depends on which jockey pulley is thrown into contact. This reversible shaft is coupled to the planer in any manner desired, usually by means of a slipping clutch or coupling. In some cases the slipping clutch is incorporated in the reversing mechanism itself.

The principles followed in evolving this device were: The reversing shaft with its pulleys must be kept as light as possible to reduce inertia effects on reversal; the driving shafts, pulleys and all other parts revolving in the same direction must be made heavy to take advantage of a great flywheel effect. The slipping of the belts on the pulleys must be reduced to the smallest possible amount, and the machine must be reversed without shock and in the shortest time possible.

The jockey pulleys operate on the slack side of the belts, and cause such a large arc of contact to be embraced by the belts on the pulleys that the machine is reversed almost instantly and without appreciable slip between the belt and pulley. A little slip is necessary, however, to enable the planer table to be reversed without shock, and this is provided for by means of the adjustable slipping clutch mentioned above.

Figs. 1, 2 and 3 are diagrammatic views

*See AMERICAN MACHINIST, Vol. 27, Part 1, page 739.

showing the arrangement of the belts and pulleys on one type of this drive. Shaft *A* is driven by a motor or from a line shaft in the direction shown by the arrow. Shaft *B* is driven by *A* in the opposite direction and at a slower speed by means of gears, the difference in speeds of the two shafts being arranged to suit the cutting and return speed desired. *B* is the drive for the cut and *A* for the return. If desired a change-speed box may be interposed between *A* and *B*, giving a variable cutting speed and a constant return speed. At *C* is the reversing shaft; *D* and *E* are the jockey pulleys. The jockey pulleys are hung on swinging arms, and coupled by means of adjustable connecting rods to a rocking shaft *F*.

As shown in Fig. 1, the jockey pulleys are in the off position; both belts are running free, and the shaft *C* is stationary. When shaft *F* is moved counterclockwise, both jockey pulleys move to the left, *E* comes into contact with the belt driven by *A* and gives motion to the shaft *C* in the direction shown in Fig. 2. Fig. 3 shows the reverse motion.

Fig. 4 shows the complete drive with the belts arranged vertically, and with gears arranged for two cutting speeds and a constant return speed. This arrangement is provided with a slipping clutch on the driving pulley for the cut, as shown at *A*. The driving pulley for the return is not shown with a slipping clutch, but can, of course, be so made if desired. On the upper driving shaft *B* are shown two flywheels *C C*. The energy stored in these flywheels smooths out the power "peaks" demanded by the reversal of the planer, and this makes the supply of power more uniform. The driving shaft *B* carries a pulley (shown dotted) for a belt connection to the line shaft; or a motor may be direct coupled if required.

The Operating Mechanism

The rocking shaft operating the jockey pulleys is shown at *F*. At *D D* are ball-bearing eccentrics coupled to the swinging jockey-pulley frames *E* by adjustable connecting rods. Fig. 12 shows this arrangement in detail, and Fig. 13 shows the details of the ball-bearing eccentrics. The rocking shaft *F*, Fig. 4, is operated by the dogs on the planer table. Several methods of operating this shaft by the dogs are used according to conditions. In small sizes of planers the shaft *F* is connected directly to the planer dogs by means of cranks and connecting rods. In the larger sizes, however, the shaft *F* is operated by power, using either compressed air or electric power. The planer dogs actuate a three-way air cock, or a three-way electric switch, respectively, as the case may be. In Fig. 4 the dotted lines at *G* show the location of the air cylinders when compressed air is used for operating the rocker shaft. Fig. 5 shows in section and end view the complete arrangement of cylinders and air cock. At *A* is the three-way air cock actuated by the planer dogs; *B* is a double piston with rack teeth cut in its upper edge. This rack meshes into a piston, shown at *H*, Fig. 4; the pinion is keyed to rocker shaft *F*. The chambers *D*, Fig. 5, are for carrying spiral springs; the purpose of these is to return the piston to the central position when both ends of the cylinder are open to exhaust.

Fig. 6 is a longitudinal section in detail of Fig. 5. In Fig. 7 is shown a cross-section through the air cock, while Fig. 8 is an end view of the cylinder. Fig. 9 shows the piston with rack. These views are self explanatory.

When electric power is used for reversing the belts, the arrangement is practically the same as for compressed air, except that magnets are substituted for the air cylinders, and a three-way switch for the air cock.

Fig. 10 shows in detail a slipping clutch combined with a bevel gear. This style is used where it is desired to place the reversing drive at right angles to the planer. The piston which meshes into the bevel gear is keyed to the reversing shaft.

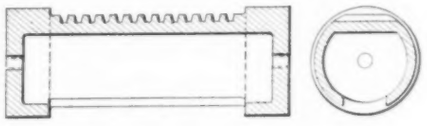


FIG. 9. AIR PISTON AND COCK

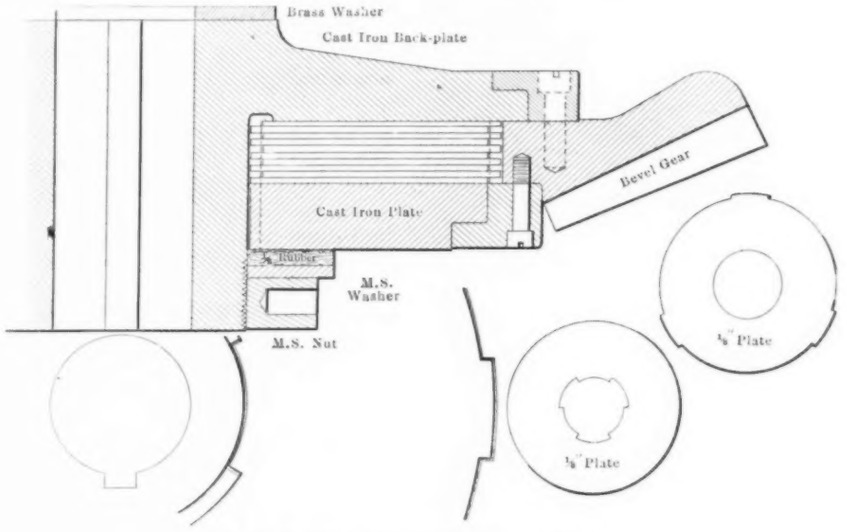


FIG. 10. DETAILS OF BEVEL GEAR AND CLUTCH

Curves of Actual Performance

In Fig. 11 are shown curves plotted from tests taken of actual performances of a 10-foot planer; first, with the ordinary shifting belts; second, with a reversing electrical motor; and third, with the Mitchell drive. These tests were taken on the same planer, and with a 10-foot cut and return in each case. With the shifting belts the cutting speed was 16 feet per minute, and return 42 feet per minute. With the reversing motor the cutting

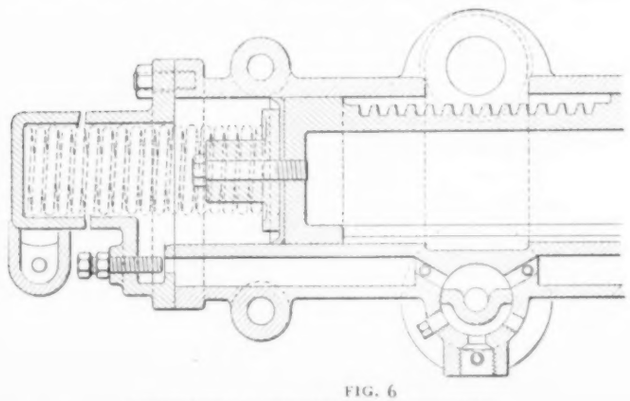


FIG. 6
LONGITUDINAL SECTION OF AIR CYLINDER

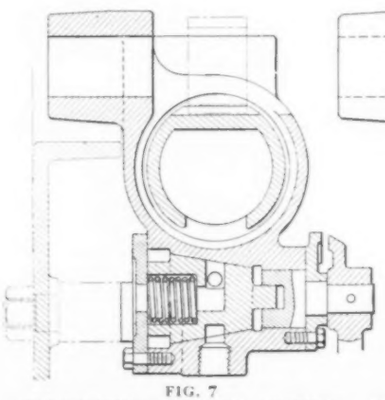


FIG. 7
CROSS-SECTION THROUGH AIR-COCK

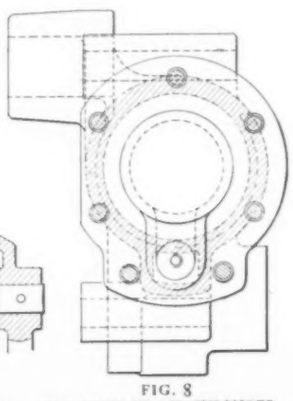


FIG. 8
END VIEW OF AIR CYLINDER

speed was 19.5 feet per minute and return speed 46 feet per minute. With the Mitchell drive the cutting speed was 40 feet per minute, and return speed 80 feet per minute. The conditions of cutting and material used were as near as possible the same in each case.

The curves are plotted vertically in horsepower and horizontally in time in seconds. In the curves, the broken line represents the performance of the shifting belts; the dotted line, the reversing motor; and the full line the Mitchell drive. It will be seen by these curves that the shifting belts required 53 seconds to complete one cycle; the reversing motor, 45 seconds, while the Mitchell drive only required 24 seconds.

The power peaks in these curves are very interesting as showing that the effects of inertia are more apparent in the driving mechanism than in the planer table and gearing. With the reversing motor it required five seconds to reverse the planer from a return speed of 46 feet per minute to a cutting speed of 19.5 feet per minute, the power rising to a maximum of 67 horsepower for one second. With the shifting belts it required five seconds to reverse from a return speed of 42 feet per minute to a cutting speed of 16 feet per minute, the power rising to a maximum of 55 horsepower for one second. With the Mitchell drive it required three seconds to reverse from a return speed of 80 feet per minute to a cutting speed of 40 feet per minute, the power rising to a maximum of 45 horsepower momentarily. The shape of the peaks would indicate that the reversal of the planer table was instantaneous with the Mitchell drive. There was, however, absolutely no shock to the planer, the energy given out by the table on coming to rest at the end of each stroke at this high speed being perfectly absorbed by the slipping clutch. The horizontal line in the first part of the curves shows the power required to drive the gears with the table lifted off, and it will be noted how small is the amount of power required to do the actual cutting, as compared with the total power used. It will also be noted that the rate of horsepower for the cut and return strokes is nearly the same for the reversing motor as for the Mitchell drive, although the speeds are nearly doubled in the latter.

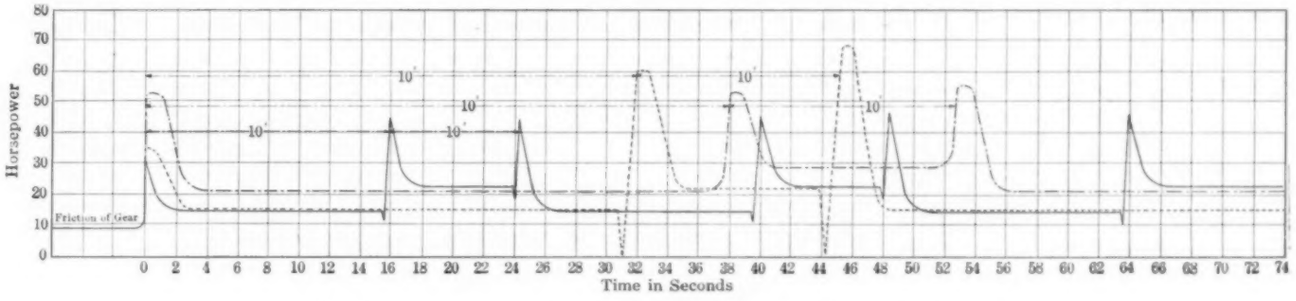


FIG. 11. POWER AND TIME DIAGRAM OF ONE COMPLETE CYCLE OF A 10X30 FOOT METAL PLANER

Ordinary shifting belt—cut 16 feet per minute, return 42 feet per minute. One cycle 10 feet cut and 10 feet return = 53 seconds.
Reversing electric motor—cut 19.5 feet per minute, return 46 feet per minute. One cycle 10 feet cut and 10 feet return = 45 seconds.
Mitchel reversing gear—Cut 40 feet per minute, return 80 feet per minute. One cycle 10 feet cut and 10 feet return = 24 seconds.

The Device is a Distinct Piece of Mechanism

It should be pointed out that the Mitchell drive is a distinct piece of mechanism in itself, and is, therefore, as perfectly adapted for application to existing planers, as of being incorporated in the design of new machines. It should also be noted that in every case in which the Mitchell drive has displaced other forms of reversing drives on planers already built, the speeds have been increased, without changing or strengthening any parts of the planers, and in many cases dispensing with most of the gearing.

A planer equipped with the Mitchell drive will plane to a straight line without overshooting, and the reversal of the table at the highest speed is effected absolutely without shock, thus showing the advantage of the slipping clutch in this drive.

A process which makes possible the substitution of steel for malleable iron in many articles of light hardware has been invented, and is described in the *Engineering and Mining Journal*. The method is founded primarily upon the idea that as two pieces of metal of unequal section do not unite readily to form a good weld, two points, or a point and a ridge, must be raised on the pieces to be united. These raised contacts are forced together under hydraulic pressure, and, forming the link of lowest conductivity in an electric circuit, are heated by the current to a temperature at or near fusion; the two projections are thus quickly united and form a bond or rivet which is even stronger than an ordinary rivet, because it is in one piece with the body of the metal.

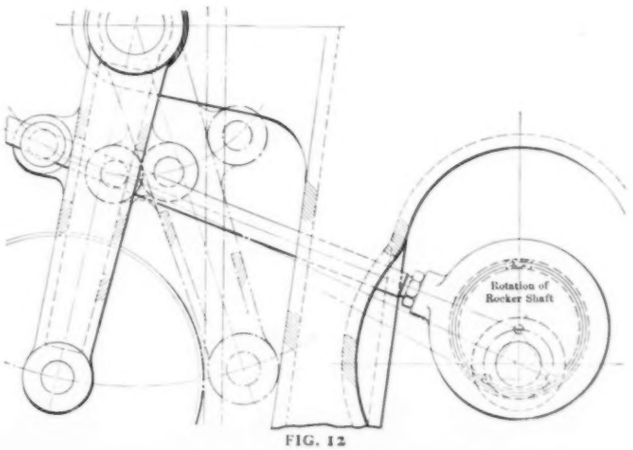


FIG. 12
DETAILS OF REVERSING MECHANISM

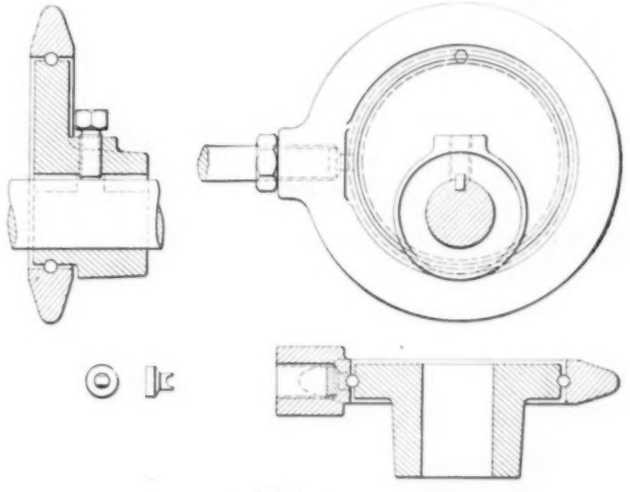


FIG. 13
DETAILS OF ECCENTRIC

Salient Points for Inventors—Infringement

By John D. Morgan

There is some confusion in the use of the terms "interference" and "infringement." Interference arises when two or more inventors claim the same invention. The disputed subject matter is awarded to the first inventor. It most frequently arises between inventors having applications for patent pending in the Patent Office at the same time for the same invention. Some idea of this on its practical side, has probably been gained in the prior article on "Diligence." There are cases where an issued patent and an application still pending are involved in an interference proceeding in the Patent Office, but this need not be dwelt on here, the present purpose being merely to distinguish clearly between terms. Two patents which cover the same thing may be put in interference by the United States courts, but this also is merely mentioned in passing. Interference involves the relation of two patents or applications for patent to each other.

Infringement is where a machine or thing embodies the subject matter of a patent claim. The question involved is that of the relation of a machine or thing to a patent. There are, of course, patents for processes or methods of doing things, but it would merely complicate matters to go into this in detail. Infringement is the unauthorized making, using, or selling of a machine or thing protected by the claim or claims of a patent.

How Infringements Are Stopped

The Government in the patent has granted to the inventor the exclusive right to make, use and sell the invention. That means that nobody else may do these things. The Government, however, will not of its own motion prevent the unauthorized doing of them. The owner of the patent must sue the infringer. If the owner does not think enough of his rights to prevent anybody trespassing on them the Government does not care. If, however, the owner goes into court, and makes his case, the Government is then very diligent to enforce his rights for him. In principle, the patent is property just as a field is property. If the owner of the field does not object, a person may trespass thereon with impunity so far as the Government is concerned, but if the owner brings the matter into court, the Government will then enforce his rights.

It will be seen, therefore, that the nature of the patent monopoly is such that a man is given ordinary property rights, in the invention, such as a deed to a piece of property would give him.

What is Considered in an Infringement Suit?

In an infringement suit the owner of the patent points to the infringing machine or other thing and says: "It infringes my patent." He points also to the infringer and says: "Stop him doing it, and make him pay me for what he has already done." The other party in defending himself points to the patent and says: "It is worthless—invalid—but in any case my machine does not infringe it." The court in such case will first fix its attention on the patent. It asks: "Is the patent valid?" This means, in other words, is that which is covered by the claims novel and does the patent in other ways meet the law? If the patent is invalid, that ends all. If valid, the court then asks: "What do the claims mean? What do they cover? Do they cover this machine or thing which is complained of?" It is on this point that the suit finally turns. If the answer is "No," the defendant goes free; if "Yes," an injunction issues against him and he must pay costs or damages.

While these proceedings have been stated very briefly, the parties frequently go to great lengths in presenting testimony each to support his position. The Government does not guarantee the validity of patents issued by the Patent Office, nor will it restore the filing fees upon which a worthless patent was granted. The patent, however, stands or falls claim by claim, and one or more claims of the patent may be declared worthless while others are declared valid.

The Penalty for Infringing

A great deal has been heard about injunctions of recent years, but it may be well to define one roughly as an order of the court directing a person or corporation to do or not to do a certain thing. Disobedience is punishable with fine and imprisonment as a contempt of court. Damages to trade of the patentee, or the profits made by the infringer, at the option of the party, may also be collected.

The injunction, however, forbidding further infringement is a very powerful weapon in the hand of the owner of a valid patent. It does not matter how much special machinery the infringer may have bought, how much may have been spent by him in advertising or otherwise developing a trade, no matter how much time has been given to the project, if a patentee makes his case, the court will say to the infringer "stop," and there is no escape.

What Constitutes Infringement

The general answer is easy. It is any machine or other thing which embodies the subject matter of the claims, and is, therefore, protected by the patent. In a given case, however, the answer is not so easy. Even after it has been decided that the patent is valid, and the meaning of the claims has been determined, if the supposedly infringing machine is in some degree different from that described in the patent, it may be a very difficult question to tell whether the claim still covers it. No general rule that will fit every case can be stated. General principles there are, but they require expert knowledge to apply them, and sometimes all expert knowledge can do is to declare a debatable case. Adjudication by the court in such cases is frequently the only means of determining the question.

Some General Facts and Principles

Among the things to be remembered are:

(a) The issuance of a patent by the Patent Office is no indication as to whether or not a machine of such patent infringes the claims of some other patent.

(b) The validity (depending usually on novelty) of any patent on which suit is brought is carefully gone into by the court.

(c) Where infringement is established, an injunction may be obtained forbidding future infringements.

(d) A machine need not be precisely like the one described in a patent in order to infringe its claims.

Equivalents

Changes in form may be quite extensive without much change in principle. One judging by external appearances might readily conclude that the claim was not infringed. It is largely a question of whether the principle of operation is the same. A fairly broad and well drawn patent application should protect everything operating on the same principle. It will be quite clear that the extent of this ability to protect is what largely gives commercial value to the patent. The commercial value of a patent breaks up into two general features. First, its ability to prevent others from making the patentee's particular machine; and second, its ability to prevent others from making any machine which will compete with that of the patent; in other words, any machine for doing the same thing.

A narrow patent will do the first, while a broad patent will do both. A patent may be considered broad in a practical and commercial sense when it prevents the building of any machine which is able to compete with the patentee's, although it might be possible to build a much more expensive and hence commercially impracticable machine in spite of the patent. The claims of a patent are not to be taken literally in all cases. The claim is usually a combination of elements. The inventor has gathered together in his machine a number of elements each old as considered by itself, but as assembled and associated by him they operate under the law or principle of the invention to do something new, or to do something old in a new way. The claim recites this fact by setting forth these elements "in combination."

Now if the claim includes a spring as an element and another incorporates the combination in his machine, but substitutes

for the spring a weight, or a weight and a lever, he would be adjudged an infringer just the same. This will give some idea of what is meant by an equivalent. It is, practically, anything substituted for an element in the combination which leaves the combination to produce the same results in practically the same way as before.

The Range of Equivalents

How far will a court go in applying this doctrine of equivalents? The general rule is very clear. In a broad patent which, in a sense, is one where an inventor has done a great deal, a wide range of equivalents will be allowed; but where the patent is narrow the range of equivalents will also be narrow. Very little can be added to this statement with advantage short of going into the matter in full detail.

Inclusion of Elements in a Claim

One thing to be closely guarded against is the inclusion in the combination of the claims of unnecessary elements. While the courts have held themselves free to read a liberal interpretation for elements specified, where they think the patentee is entitled thereto, they state emphatically that they have no right to drop out of a claim a specified element. Great care should be exercised to exclude from the claim all elements which are necessary for doing the work for which the combination was designed. On the other hand, where an additional element is necessary, especially where it relates to driving means or things of that character, the court will not declare a claim inoperative and, therefore, invalid because such an element has been omitted. However, one who is experienced and competent should be able to analyze the machine so as to include in the claim precisely the necessary elements, no more and no less. If this is done, one of the main steps toward securing a good patent has been taken.

Graphical Representation of These Principles

If patentee claims in combination A, B, C and D as elements and another builds a machine whereby A, B and D do the same thing without C, or its equivalent, he is not an infringer. The very fact that he has done away with C shows that his machine operates by a different principle, or that the patentee included in his claim an unnecessary element. Either of these, as has been pointed out, would let the supposed infringer go.

Now let the elements be represented by capitals as heretofore, and the particular form of such elements by the letters x y, and then assuming the claim of the patent to be for a combination of Ax, Bx, Cx and Dx, and the other party builds his machine with Ay, Bx, Cx and Dx, he would probably be held an infringer. The appearance of the machine might be changed and its manner of operation to some degree, but the principle of operation of the combination would probably remain the same.

A man may be very well satisfied because of the changed appearance in his machine over that shown in the patent that he has avoided infringement, but this may be far from being the case. Where a person starts with the deliberate intention of getting the advantages of the patented machine while making just sufficient changes to avoid infringement, he is consciously doing an unfair thing, and his purpose is likely to be as apparent to those examining closely into the matter as it is to himself. The courts usually detect such a one and deal with him according to his deserts.

The Other Side of the Question

As was stated in a previous article, the patent is granted merely to cover what is novel in a machine, and it is quite possible, on the other hand, that the showing of the patent may be much more formidable than the claims. For instance, a man may show a highly organized machine in his patent, but if he has merely made improvements in the details and the general combination of the machine is not his, his claims will be limited to these details. Anyone copying the general design of the machine, but avoiding the patented details would not infringe. Such an inventor would be allowed but a narrow range of equivalents, and sometimes none at all. While many patents, therefore, are broader in their scope than a mere surface examination would suggest, other patents are much more impressive on first appearance than their claims would justify.

General Precaution

Anyone who wishes to be satisfied as to the relation of his machine to the claims of living patents should have a careful examination and analysis thereof made in view of the prior art, and in many cases such an examination can be satisfactorily made only by experienced and qualified persons. Such an examination should be made, of course, before money is spent in bringing out a new machine. The investment in such an inquiry is often "a stitch in time" such as the proverb assures us "saves nine."

It is equally foolish to be frightened away from a good field by a formidable appearing patent, which may in truth be very narrow and inefficient to protect its field, as it is on the contrary to regard with contempt, or to dismiss with inattention a broad and efficient patent which may be an insurmountable barrier between one and the field which he wishes to enter. Such an examination will develop either (a) that the field in view may be entered, or (b) the field is absolutely closed, or (c) that it is a debatable question. If the field is closed and the fact is known in advance the patentee controlling the field can be approached and the matter of license, royalty, or other privilege, if obtainable at all, may be discussed from a vantage point not available to the defeated litigant with a useless plant on his hands and an injunction standing against him.

Where the question as to whether or not the field is debatable, pretty accurate knowledge may be obtained and one may decide definitely whether he wishes to enter a struggle, the outcome of which is doubtful, or he may decide whether he wishes to treat with the patentee, or he may decide on any other course with his hands free and with his money under his own control.

Resume

(a) Interference is a conflict of claims to a patent right.

(b) Infringement is trespass upon a patent right.

(c) The patent owner, not the Government, begins legal proceedings to stop infringers.

(d) Rights of patentee and infringement being proved, the Government will then enforce rights.

(e) The court looks closely into the validity of the patent.

(f) The court looks closely into the question of infringement.

(g) Equivalents are allowed the inventor for the elements specified in his claims.

(h) The range of equivalents allowed varies with the greatness or importance of the invention.

(i) Injunction obtained from a court forbidding further infringement is the formidable weapon of owner of valid patent.

(j) Damages or profits are also collected from an infringer.

(k) Preliminary opinions on questions of infringement are frequently of great value.

From the results to be gained from tests made by a unique timber-testing machine the Forest Service expects to be in a position to calculate by a more reliable and accurate method the stresses that timbers will be able to withstand safely in bridge and other engineering projects. A machine is to be built at the University of Washington under designs furnished by the U. S. Forest service that will definitely determine how the strength of timber is affected by shocks and repetitive loading. The machine will have a 1500-pound hammer, capable of being dropped on samples of wood from varying hights up to three feet, and is automatically hitched up in such a manner as to permit a complete record to be kept on a roll of paper that is fed from one cylinder to another.

Practical Letters from Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

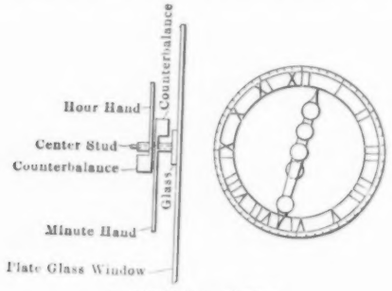
WE PAY FOR USEFUL IDEAS

Echoes from the Oil Country—A Peculiar Clock

One day I saw a clock that had some peculiarities. It was on a store window. Not setting or standing in the window, but fastened to the plate glass, and several feet away from anything else.

On a piece of glass which was cemented to the glass of the window was a stud that projected horizontally away from the window glass. There were two hands. These hands had each a hole in the center that was a loose fit on the stud. These holes were not in the center of length, but rather in the center of gravity. Of course, a block hand with two ends of equal length would be rather confusing, and to avoid such a construction a counterbalance was put on one end of each hand. In a circle about three feet in diameter the hour and minute marks were painted on the glass of the window. The sketch will give some idea of how this clock looked. That is all there was to the clock. Just two hands and a stud for them to revolve on, and not the slightest chance for the finest of wires to be connected to it in any way.

This clock, although so naked looking, would run and it would keep reasonably good time as compared with the numerous watches that were glanced at as their owners stopped to gaze. Not only would this clock do its best to keep time, but if one of the hands was moved away from



A PECULIAR CLOCK

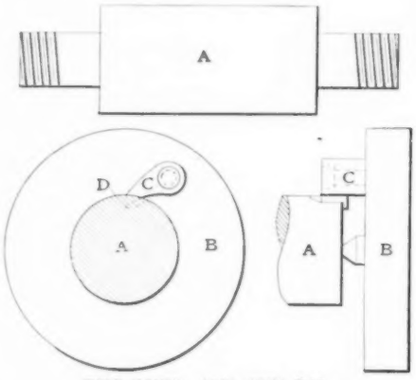
the correct time it would return to it when released. Either of the hands could be revolved freely on the stud and as it came to rest it would be found indicating the time just as though it had not been interfered with. Further than this; either of the hands could be removed and carried around or hung upon the wall or taken out of the room, and yet when returned to the stud it would point to the proper place for indicating the time and then keep on doing it until again interfered with.

This clock was built on scientific lines and no doubt all of the older mechanics will at once understand all about it, but it may cause some of the younger ones several minutes' thought before they are able to see how it was done. Not wishing to spoil the fun which they may have with it I will not send along the explanation which I was forced to make to a very dear friend of mine to save my own reputation as a mechanic. Neither will I send the model which I made to elucidate my explanation.

Oil City, Penn. W. OSBORNE.

A Dog Used in Turning Bridge Pins

The finished pin *A* is shown at the top of the illustration. These pins vary in size from 6 inches or so in diameter down, and are various lengths.



THE WORK AND THE DOG

The stock is cut from the bar by a cold saw and then centered. A groove *D* is cut in one end with a chisel. This groove engages the pawl *C* hung on the face plate. The pawl is of suitable length and pivoted so that it will drive any size of pin being turned. After one end is turned and threaded, a threaded split dog is used to finish the other end. The bridge pins are made in great numbers and this dog saves considerable time in the aggregate.

New York. JAMES WATT.

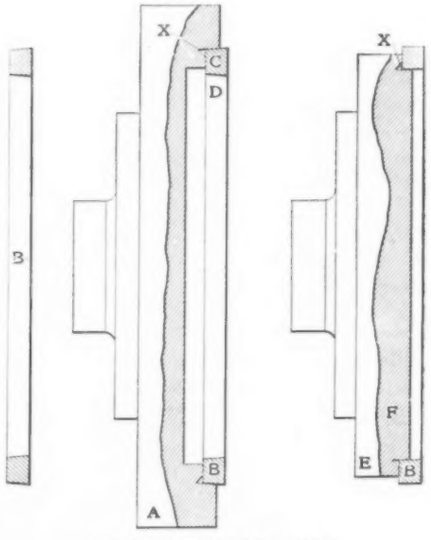
Chucking Slender Work

Occasionally one has slender work to chuck which the regulation chuck will not handle satisfactorily. As an illustration I will take some rings I once had to turn. As near as I can recollect these rings were about 12 inches diameter, ¼ inch face and about ⅜ inch deep. The drop forgings came to the shop in the shape of plain rings, with quite a lot of taper. They were made this way so that they would draw out of the die they were forged in. There were only a few of them so it would not pay to go to any great expense in the making of special chucks.

At a nearby wood turner's I got a log of dry gum wood about 14 inches diameter, from which I sawed several disks about 2 inches thick. One of these disks *A* was fastened to the small face plate of the lathe and bored, as shown, a snug fit for the rings. Not a *driving* fit, as that would have sprung the rings, and anyone who has used wooden chucks knows the friction of an *easy* fit is sufficient to carry quite a heavy cut.

After pressing the rings *B* in one at a time they were faced at *C* and bored at *D*, the sharp corner where the two cuts met being touched with a smooth file.

When all the rings were turned on one face and bored another of the wooden disks was mounted on the face plate and



CHUCKING SLENDER WORK

turned, as shown at *E*, with a small spigot *F*. This spigot need not be made as deep as the forging. For a ring ¼ inch thick, as this one was, it need not be more than 3/16 inch high, and ⅛ inch would probably be ample if care is taken to have the fit right and the work pressed on with a little chalk.

When the second chuck was finished the rings were pressed on one at a time with the finished face next to the wood and the remaining side faced and the outside turned to dimensions.

In cases where the work is to be very accurate it is better to rough-turn the rings in the same way I have stated, leaving enough for a little finish all over, then refit the chucks and repeat the operations. In this way any slight winds in the work caused by the strains being released when the skin is removed will be taken out in the finishing cut.

As a suggestion to anyone who wishes to use wooden chucks, but who lacks the experience necessary to select the best wood: For large chucks gum wood is good; I have seen it as large as 20 inches diameter, and I understand that it comes in still larger logs. For small chucks the best wood is box; it turns well and is very durable; the great objection to it is its cost. English box wood comes in small sizes only, but is the best. Turkish box wood can be had in much larger sizes; I have seen logs a foot in diameter. Other good woods are apple and pear. In almost every case it is best to make the wooden chucks of end wood, and the wood ought to be dry. It will be noticed that the wooden chucks are relieved at *X*. This is necessary so that the ring beds on the face of the wood. In forcing the ring on a bur of wood is liable to be thrown up, and if the corners were made square in the chuck the bur would not allow the ring to seat.

New York. E. A. DIXIE.

A Fixture for Shaping Governor Sleeves

Having a quantity of brass governor sleeves for steam engines, shown at Figs. 1 and 2, frequently coming through the shops, we designed the fixture shown in Fig. 3 for the rapid production of these castings on the Hendey shaper, also shown in Fig. 3.

The castings are first bored out in a lathe to 2¼ inches diameter and turned on the ends on the collars marked *X* in Fig. 1. They are then taken to the shaper and completed on the outside surfaces, 1 to 8, inclusive, as shown in Fig. 2.

Referring to Fig. 3, *A* is a gray-iron casting bored to receive the steel spindle *B*, which is hollow, as shown by dotted lines, the outside being the standard Brown & Sharpe 45-degree and 2½-degree taper, to prevent end play and compensate for wear. *C* is a steel division plate which is keyed on *B* and has four notches milled in the periphery, at 90 degrees apart. *D* is a worm wheel, also keyed on *B*, with the same key as *C*. *E* is a lock nut which screws on the spindle *B* to keep the worm wheel *D* and division plate *C* adjusted up to the faced end of the bracket *A*. *F* shows the back end of the spindle *B* which is provided with a fine thread to receive the lock nut *E*. *G* is a bracket, which is cast solid on *A* and has a bearing on each side, bored out to carry the worm spindle *I*, which has a worm keyed on engaging with the worm wheel *D*. *H* is a steel disk keyed on *I*, and having notches milled in the periphery, in which a spring plunger operates in the ordinary manner to give motion to the worm wheel *D* and spindle *B* by rotating *I*. *J* is a bracket also cast on *A* and bored out at *K* to carry a spring plunger for locking the spindle *B* by operating in the notches in the dividing plate *C*. *L* is the ordinary semi-rotary feed plate on the shaper, and *M* is the T-slot across it for adjusting the feed by the ordinary clamp dog. A feed rod is connected to this clamp dog in place of the ordinary feed rod, and coupled up to the spring plunger on *I*, and thus gives motion to the spindle *B* for the circular part of the work marked 7 and 8.

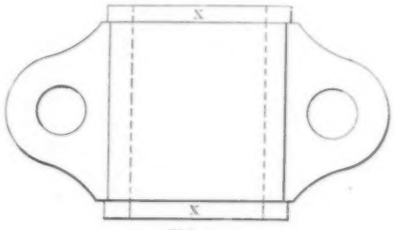


FIG. 1

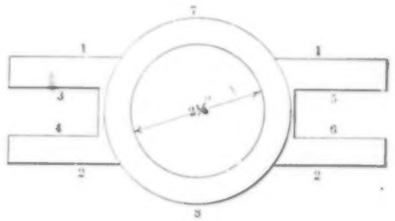


FIG. 2

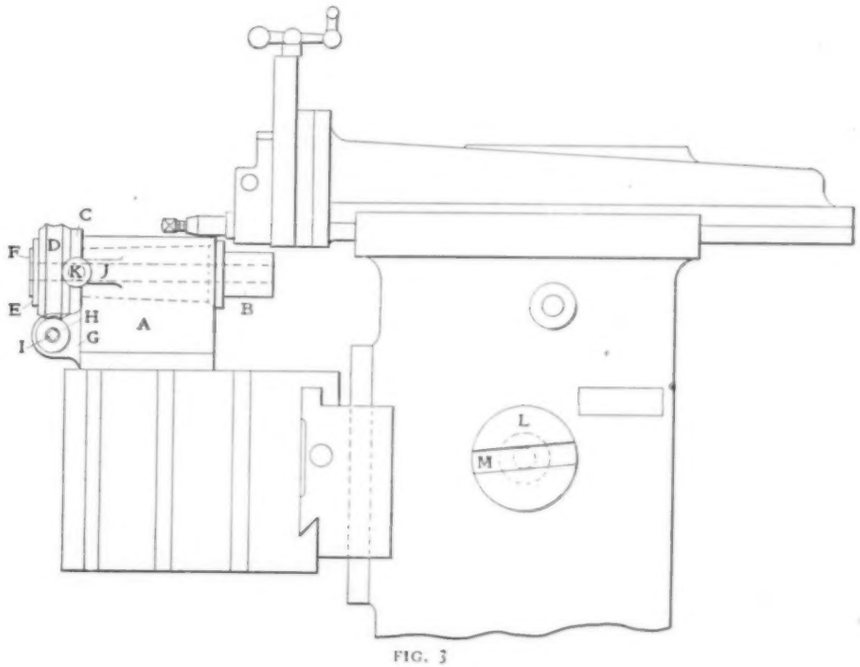


FIG. 3

FIXTURE FOR SHAPING GOVERNOR SLEEVES

The work is slotted on the end of the spindle *B* (which should be a good fit) and set level across the lugs, with a surface gage to the sizes already marked out. A bolt passes through the spindle and secures the work by a clamp washer at the back end, the work projecting ⅛ inch beyond the end of the spindle to allow of this. The flat surfaces of the lugs marked 1 are first shaped down to size by the ordinary table traverse, the plunger *K* holding the work securely in position for this operation by engaging with the dividing plate *C*. After the surfaces 1 have been completed, the plunger is withdrawn and the spindle *B* is turned half a revolution by hand with a handle on the worm spindle *I*; the plunger *K* then locks the plate *C* for operating on the faces marked 2 in exactly the same manner as the faces 1 were finished. When these are completed withdraw the plunger *K* from the plate *C* and turn the spindle *B* a quarter of a revolution, and lock with plunger again, and operate on the inside faces 3 and 4 by the vertical hand feed, and also scrape up the bottom of the slot. After this is completed, turn the spindle half a revolution, and operate on the faces 5 and 6 in exactly the same manner, which completes the straight faces.

Now disconnect the feed rod with the table, and couple the longer one up to the worm spindle *I*, and operate on the circular portions 7 and 8, which is quite as simple as shaping the straight faces. This completes the casting, which has to have a first-class finish and be highly polished.

We have also done other circular and semi-circular work on this fixture, including brass fire-hose couplings, and the

sleeves for motor-car multiple-disk clutches, and it has saved its cost many times over during the two and a half years we have had it working.

Manchester, England. B. R. ASHE.

Parallel-depth Bevel Gears

The method of cutting bevel gears about to be described was devised some years ago in my shop by A. A. Wood, of this city, for a small machine he was then perfecting. We have used, and still use, where it is necessary to duplicate or match existing wheels, the Brown & Sharpe system; but find the new plan so much simpler and superior in every way that we have adopted it for all new work, and for replacements where the conditions permit its use.

By this plan of producing bevel or miter gears, special cutters are not needed; the ordinary stock cutters used for spur gears answer every purpose, and produce far better results. Besides, not needing special cutters, we are not limited to length of tooth, as almost any length of tooth, within reasonable limits, can be cut. The teeth of the pair of gears match perfectly without the necessity of filing or rounding them off on top, as required by the old method, as the cutter leaves them in proper shape. Also, there is absolutely no guessing about the matter; everything is determined beforehand and the gear is produced without any cut and try, and with the positive certainty that it will be right when finished.

In using this plan the number of teeth are calculated on the inner or smaller-pitch circle, or having a required number of teeth, the pitch diameter is calculated for the inner pitch circle, selecting a pitch that will be of suitable strength for the work to be done, always bearing in mind that the teeth of bevel gears produced by this plan will be several times as strong as those made by the usual method because the tooth grows thicker toward the larger diameter. Thus a finer pitch should be selected than would be for a spur gear to transmit the same power in order to make a better proportioned gear. The samples shown in the half-tone, Fig. 3, are a pair of miter gears, 25 teeth, 10 pitch 1-inch face, No. 2 cutter. We have cut a number of bevel gears of different pitches and numbers of teeth, both miter and bevel, and have found them to give good service, some of them running at high speed.

You will note from the illustration the excellent way in which the teeth contact. They appear a little odd at the outer ends because of the shortening, or rather broadening of the teeth; but a little reflection will convince one that this is really a benefit rather than a detriment, giving a very strong tooth with good wearing qualities. They run smoothly and quietly, and have proved very satisfactory in our practice.

METHOD OF LAYING OUT

Having determined the pitch and number of teeth for both wheel and pinion, lay out the pitch and circle of the wheel *A*, Fig. 1. Draw the line *B* and at right angles thereto lines *C* and *D*; on the line *C* draw the pitch circle *E*; draw the line *F* through the center of *E*; then through the intersection of *F* and *D*, and *G*, *H* and *I* draw pitch-cone lines *J* and *K*. Then the angles *L* and *M* will be the proper setting for the dividing head, and also, be the angles to turn the gear blanks for the tops of the teeth. The diameter is plus one part of pitch above the pitch line as at *O O* and *P P*. Now draw the back-cone lines *R* and *S*. Twice the distance of *R*, in inches, will be the pitch diameter of a spur gear, the number of teeth of which should be used to select the proper cutter for the wheel; twice the distance *S*, in inches, will be the pitch diameter of a spur gear, the number of teeth of which should be used to select the proper cutter for the pinion.

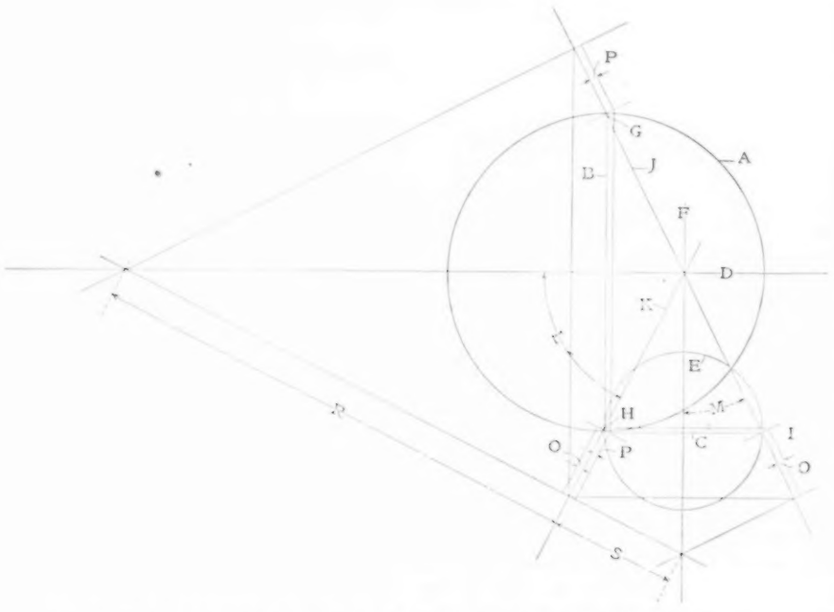


FIG. 1. DIAGRAMMATIC LAYOUT OF A SET OF PARALLEL-DEPTH BEVEL GEARS

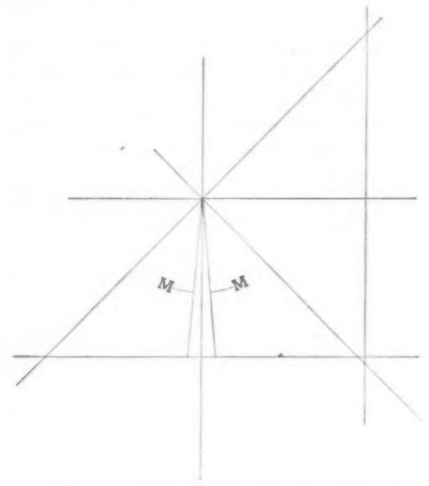


FIG. 2. DIAGRAM OF SIDES OF TEETH

It will also be noted that the top and bottom of the teeth are parallel with the pitch line as in a spur gear. This angle is also the correct setting of the dividing head when cutting the gear, the bottom angle is the same as the angle of the pitch cone. The teeth can be produced by two cuts, and will give good results on pitches up to, say, 6-pitch. It is better in cutting coarser pitches to first cut the teeth through straight on the center; then set over sidewise, first for one side of the teeth, then for the other side, and finish the teeth with three cuts. The proper amount to set over sidewise is *always* just one-half the thickness of the cutter at the pitch line, each side of the center, because the contact or working surfaces of the teeth of bevel gears must converge at the point where the axes of the shafts meet—excepting skew bevels—and by setting over sidewise one-half the thickness of the cutter at pitch line, the side of the cutter at the pitch line is brought over the center line of the gear, and, of course, will cut the side of the tooth so that if it were continued it would meet the point where the axes of the shafts meet; but it is not necessary that the line of the tops and bottoms of the teeth meet at the same point. In other words, our gears are two cones whose contact surfaces are the pitch line, or pitch cones; the teeth are formed partly above this surface and partly below it. It is not necessary in a practical working gear that the tops and bottoms of the teeth converge at the vertex of the cone, but may be made parallel to the pitch line as at *O O* and *P P*, Fig. 1. But the sides of the teeth must meet at the vertex as at *M M*, Fig. 2.

Having set over one-half the thickness of the cutter, rotate the gear until the cutter will just come into the cut at the inner circle without touching either side, carry the cutter through, then set over in the opposite direction one-half the thickness of the cutter as before, turn the gear back until the cutter will come into cut as for the other side and carry the cut through on this side of the tooth, thus finishing one tooth space. Now, without changing the setting, cut the rest of the teeth around the gear, then set back to the setting for the first side of the tooth and go around the gear again, cutting the other side of the teeth; this will complete the gear with two cuts to each tooth, and if the work has been carefully done the gears will be finished, and require no filing or doctoring of any kind. They may be put into service at once. They will run as surely as a pair of properly sized and cut spur gears.

The lathe work on the blanks needs to be good, ordinary, machine work, being careful that the face angles are correct, as this is the only angle of importance. This face angle will also check the setting of the dividing head on the milling machine, as the cutter should just touch across the face, as in cutting spur gears. Or, assuming that the dividing head is set to the correct angle, this will check the correctness of the lathe work. This ability to check lathe work against milling-machine work, and milling-machine work against lathe work, insures against making any mistakes in cutting an improperly turned blank. There is no good reason for any mistake or failure to produce by this method any bevel gear wanted, positively and accurately from start to finish; all of the work is predetermined with the same certainty as the production of spur gears.

Atlanta, Ga. RIDLEY.

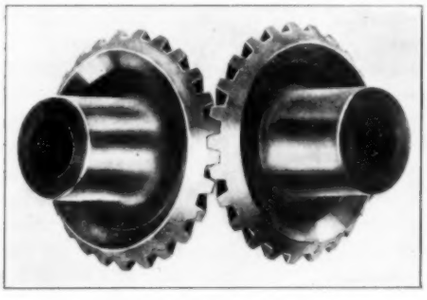
The above title was given to this article, mainly because it was the name given to the gears under consideration by the parties who have been using them. The term is not strictly correct, as the following description will show, but it has the floor until something better appears. I saw a pair of gears, that were cut by the method herein described, in the tool room of a large factory where they were just finished for a special machine. They ran so smoothly, and the method of cutting was so entirely different from usual, that I was much interested and think some of the readers of the AMERICAN MACHINIST may be also.

I have no theories to advance, but will tell what I saw, and was told about the cutting and using of them by the man who cut them. He was a middle-aged mechanic who claimed to have cut gears by this method for a number of years. If the method is as good as it looks it ought to be more generally known. If it is an old scheme, that has been tried out and found wanting will someone let us know about it?

The real differences between these gears and the usual bevel gear consist in two things: First, the normal pitch diameter is located at the inner end of the teeth instead of at the outer. Second, the center angle, face angle and the cutting angle are identical. This gives a tooth of standard hight at all places (whence the name "parallel-toothed gears") and a very strong tooth, for, as the thickness of the teeth on the pitch line is standard at the normal pitch diameter and the hight is standard at all places, it follows that the thickness is greater than standard at all places outside of the normal pitch diameter; hence we have a thick, strong tooth. Referring to Fig. 4, the normal pitch diameter is the starting point when laying out these gears. It is equal to the pitch diameter of a spur gear of the same number of teeth and pitch; D and d are the same as a spur gear with standard teeth of the same pitch.

METHOD OF CUTTING

To cut use same cutter as for spur gear of diameter A, or $A \times P$ equals the number of teeth in a spur gear of diameter A. Select a cutter suitable for a spur gear with the number of teeth thus found. The cutter for the pinion must be selected by the same method from dimension A'. The



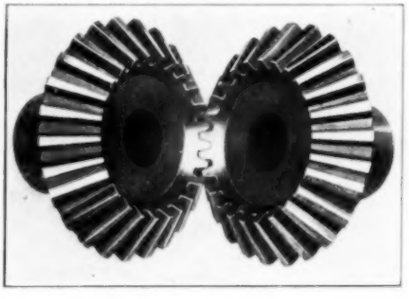


FIG. 3. A PAIR OF PARALLEL DEPTH BEVEL GEARS IN MESH

angle may be found the same as for any bevel gear; namely,

$$Tang.\ \Theta = \frac{teeth\ in\ gear}{teeth\ in\ pinion}.$$

The pinion angle $\phi = 90$ degrees $- \Theta$ when the shafts are at right angles.

$$O\ D = normal\ P\ D) + (2\ F\ sin.\ \Theta) + (2\ D\ cos.\ \Theta)$$

for the gear. The pinion outside diameter may be found by the same formula by substituting the pinion angle ϕ.

To cut the gears on any universal milling machine it is necessary to cut three times around the gear as follows: First cut, place cutter on center and cut straight through the gear at the given angle. Second cut, move the table toward the spindle one-half the thickness of a standard tooth, then roll the gear away from the spindle

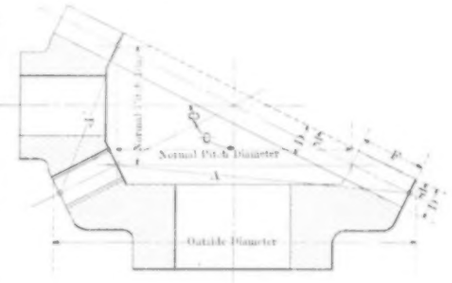


FIG. 4. PARALLEL-TOOTHED BEVEL GEARS

one-fourth as many holes as are used altogether to space between teeth and cut through. Third cut, move the table away from the spindle the full thickness of a standard tooth, then roll the gear toward the spindle one-half as many holes as are used altogether and cut through. This finishes the gears ready to run.

Bridgeport, Conn. S. K. ALLEN.

[The type of gear described in the two foregoing letters is by no means new, as it was mentioned by A. D. Pentz on page 6 of our issue of September 10, 1891. The principles of cutting such gears with ordinary spur-gear cutters were very fully explained by Walter Gribben on page 6 of our issue of February 25, 1892, and still farther on page 6 of our issue of June 23, 1892. The type, however, has such peculiar advantages from a production standpoint, and seems to be so little known, that we have printed these articles in full at this time.—ED.]

Revival of an Old Scheme

I have just run across a new thing in heating apparatus that attracted my attention, because I thought I had lost all the money that there was to be lost on it 10 years ago. About that time we were selling steam boilers to a man who did very nicely with a contracting business in the house-heating line until he acquired the inventive germ. This man was a salesman by profession. He did not know the first thing about the heating business that he did not pick up or dig out himself.

In the course of his traveling he was struck by the number of hotels that it was possible to find where the heating of individual rooms was a large and serious problem. He arrived at the conclusion that there was "millions in it" for anyone who could get up a scheme whereby a hotelman could send his guest a match and tell him to light the radiator and give him

steam heat all by himself with the aid of a hose to the gas pipe. He tried the scheme of running a long pipe burner under a standard cast-iron radiator; steel ones were unknown then. By housing the burner in pretty carefully he could get up steam in half an hour or so, and then he had the whole heating plant right there, furnace, boiler and radiator.

The worst of it was that the thing really worked all right, in spite of one of our wiseacres, who shook his head sadly and remarked that "he didn't s'pose that all you had to do to make the fire heat better was to put the kettle on." One drawback was that with the kind of gas they give us around here no one could live in the room with it unless they connected it to the chimney to take away the fumes. Of course, the reason why it was better than the open burner alone was because it increased the area from which the heat was radiated, though why it was any better, if it was, than the sheet-iron hot-air-gas radiators that are in common use now I do not know.

He patented the thing and he came so near to selling the patent for a hundred thousand or so, that we almost thought he could pay up our bill for boilers; but it all fell through, and when he was sold out there was very little bidding for the patent. It started at 10 cents, and, by skilful nursing on the part of the auctioneer, it was brought up to about half a dollar, at which it was sold. Whether the company that is now exploiting the same thing has the patent or not I do not know. I suspect that the thing was born too soon the first time, and I suspect that with a sheet-steel radiator, which is now obtainable, it may be possible to get up steam promptly.

The principle of the device is only the very simple one of increasing the radiating surface and not making the difference in temperature between the radiator and the surrounding air so great as to waste heat by keeping one corner of the room tpo hot in order to raise the temperature of the opposite corner above freezing.

I have heard of the same principle being used to heat by gas-engine exhaust. This was done by turning the heated waste gases through a boiler or heater very much like a tubular boiler minus the firebox, thus heating the water which is circulating the other side of the tubes, and which in turn is sent through radiators for heating the shops. If the device will work as well as it ought, it should help bridge the gap between steam and gas for power, since the chief drawback to the use of the latter has been in the lack of means for exhaust-steam heating.

Springfield, Mass. ENTROPY.

A Slotting Attachment for Locomotive Crank Axle Webs—Adjustable Keyway Slotting Tools

I am employed by a firm who frequently have to machine up a quantity of forged steel, double-throw crank axles for tank locomotives. After these axles are turned to size, they are mounted in a fixture on a large slotting-machine table, in the position shown at Fig. 1, to have the outside of the webs *I* and *J* operated upon. Fig. 2 shows a plan of the webs; these are machined all the way around.

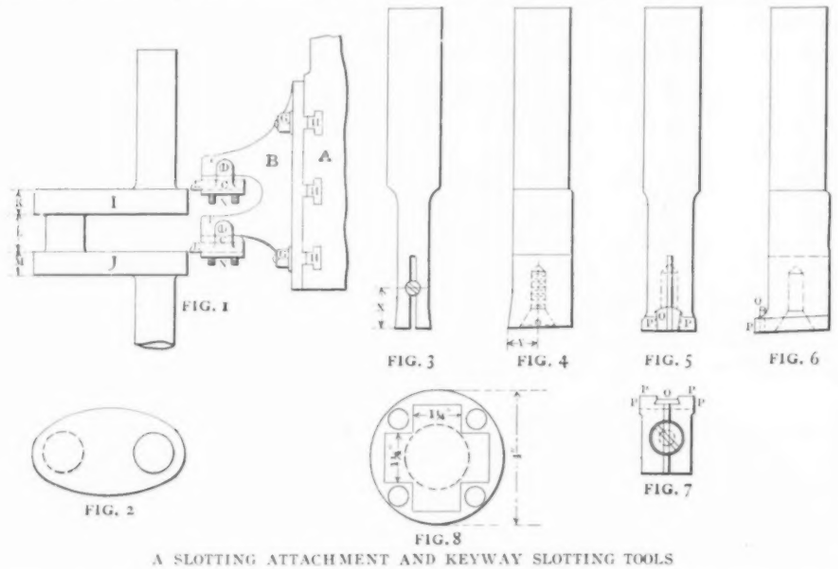


FIG. 1 FIG. 3 FIG. 4 FIG. 5 FIG. 6

FIG. 2 FIG. 7

FIG. 8

A SLOTTING ATTACHMENT AND KEYWAY SLOTTING TOOLS

To save time and reduce the labor costs of slotting these cranks, we designed the double-cutting attachment, shown in operation at Fig. 1. *A* is the slotter ram, and *B* is a steel casting, which takes the place of the ordinary slotting tool. *C C* are the two frictionless return-swivel tool boxes, which have two stout lugs on the sides, accurately machined to fit on the planed ends of *B*. These lugs are bored along with *B* and swivel on the pins *D*, as shown. *E E* are the two cutting tools. *F* is a small, steel pin which supports the top end of a coil spring fitting in a hole in *B* and secured to the tool boxes *C* at the bottom end to prevent the latter from dropping down when not cutting. *N N* are the set screws for securing the cutting tools in their boxes. *G G* are the bolts for securing the attachment to the slotter ram in place of the ordinary tool holders.

It will thus be seen that the two cutting tools *E E* operate simultaneously on the two webs *I* and *J*, and whereas with an ordinary tool the stroke of the machine would equal the entire distance across the webs and pin gap *L*. The cutting tool would only be working about half the stroke traversed, or *K* and *M*, and the distance *L* would be idle. With the attachment, the stroke is only about one-quarter the length required with a single tool, or in other words, it is the distance *K* plus the top and bottom clearance, which is about ½ inch at the top and ¼ at the bottom. We have two of these attachments in use, and find we can complete these cranks in about one-third the time we formerly could with a single cutting tool, when quite 50 per cent. of the cutting stroke was running idle.

While on the subject of slotting, I would like to say a word or two in reference to expanding slotting tools, for cutting keyways, etc., which have appeared in the AMERICAN MACHINIST from time to time. Fig. 3 shows a tool which a correspondent advocated in your columns some time ago; this was superseded and afterward shown in the improved form shown at Fig. 4, by another writer, as the distance *X* was too great, and allowed the point to close in a little, and thus cut the keyways narrow. The distance *Y* in Fig. 4 is not so great, but still it is sufficient to allow the cutting point to close slightly when working. An improvement on both these types is shown in Fig. 5, also a side elevation at Fig. 6. For keyways of 1 inch wide and over for heavy work in steel this is the only satisfactory expanding tool I have yet come across. The adjusting screw is at the bottom, as shown in Fig. 4, but the cutting edge *P* is cranked forward about ¼ inch, as shown, and filed out to receive the dovetailed steel wedge *O*, which is about ⅛ inch thick, and forms an efficient means for preventing the cutting edges from closing when working. Fig. 7 shows a plan of the bottom of this tool. Of course, the center of the keyway to be cut must be cut out first with a solid, narrow tool, leaving the finishing to be accurately performed by the expanding tool. Fig. 8 shows a machinery-steel piece 1½ inches deep, for the universal joints of an automobile live axle to work in; these have to transmit 40 horsepower, and work at a very high speed, and have to be very accurate. We have finished about 120 of these drivers with the tool shown in Figs. 5, 6 and 7, and it is still good for many more. Although the initial cost may be rather high, it has well repaid us.

Sheffield, England. SLOTTER

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

Method of Leveling and Alining Planers—Using the Microscope

The article on this subject by Mr. Thompson, at page 581, Vol. 31, Part 2, was extremely interesting, but the scheme of using a *contact* indicator in conjunction with a piano wire for alining does not appear to me to be the best device for the purpose when the wire is as long as Mr. Thompson used. The ideal thing for that job is a microscope fastened to the movable V-block with which to *look* at the wire in various positions of its length without touching it, the wire to be about at *W*, just a little above the stage of the instrument. A shop microscope, specially designed for such work, would be the best, but if that is not available, an ordinary commercial microscope may be clamped to the V-block to do the alining, as shown in Fig. 1.

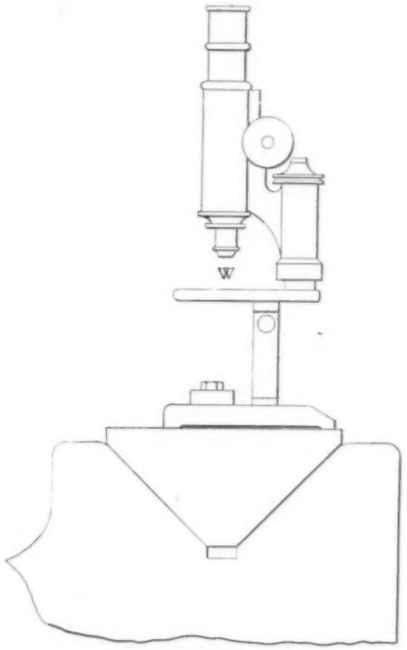


FIG. 1

TESTING ALINEMENT OF PLANER WAYS WITH THE MICROSCOPE

Of course, the eyepiece of the microscope will have to be provided with cross hairs or some other reference point, either stationary or adjustable, with which to compare the image of the wire. In case stationary cross hairs were used, the microscope could be adjusted horizontally on its V-block until the intersection of the cross hairs coincided with one edge of the wire when the microscope was near the ends of the bed, as in Fig. 2. Then if the block bearing the microscope was moved along the bed until it was directly over a set of leveling blocks, and the wire appeared as in Fig. 3, the lateral adjusting screws of those blocks could then be manipulated until the wire appeared, as in Fig. 2, and this process repeated over each set of leveling blocks.

In order to provide for the sag in the wire, the vertical focusing movement of the microscope would have to be brought into action, but this would not introduce any error, providing the focusing slide was truly vertical and its gibs were set up to a snug working fit.

With the outfit shown in Figs. 1, 2 and 3, it is not necessary to measure *how much* the bed is out of line, as the observation of the error, and its correction, take place simultaneously. However, if it was considered desirable to measure the amount of the error, the eyepiece diaphragm instead of having cross hairs, as shown in Figs. 2 and 3, could be provided with a semicircle of transparent celluloid, graduated on its straight edge as shown in Fig. 4, the graduations to be made especially to suit the objective eyepiece, and tube length used, as all these items are factors that influence the degree of fineness of the graduations if they are to represent any special value. The distance apart of the scale divisions can be found by dividing the actual diameter of the hole in the diaphragm by the length of object that can be seen at one time, and multiplying this result by the nominal value that each scale division is to represent. Thus, in a microscope in my possession, if placed on a milling-machine platen, and focused on the arbor when at rest, the cross slide of the miller had to be moved 0.0325 inch to cause any given scratch or mark on the object looked at to apparently travel from one side of the field of view to the other. When the eyepiece of this microscope was taken apart and the opening in the diaphragm measured, it was found to be 0.3475 inch. The latter divided by the former, and multiplied by 0.001, the nominal value of one scale division, gave 0.01069 inch as the actual interval between consecutive marks on the celluloid scale.

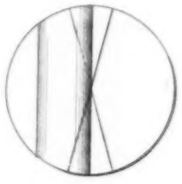


FIG. 2

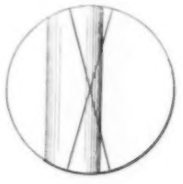


FIG. 3

FIG. 4

Brooklyn, N. Y. WALTER GRIBBEN.

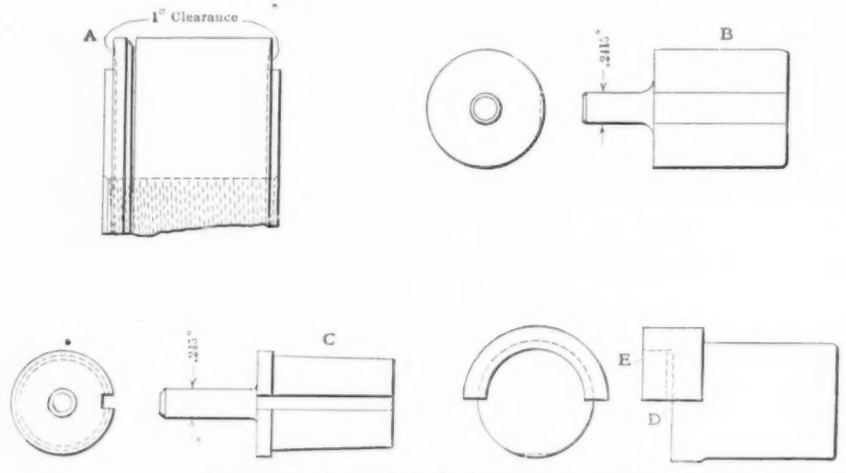
The Reduction of Cost

On advertising page 21 of October 29 issue there is an advertisement of a manufacturing turret lathe in which the statement appears, "Labor cost saving of 50 to 500 per cent." I know of only one metal-working operation in which the latter saving was reached and exceeded. The metal was an alloy white metal. The machine consisted of a heavy platen to which heavy uprights were bolted. The uprights were joined at the top by an arch. In each upright was a bearing for a shaft which passed through both uprights. On the extreme end of the shaft was a large fly-wheel which also acted as a pulley for the belt. Between the housings an eccentric was formed on the shaft. This eccentric actuated through a series of toggles, a vertically reciprocating slide. The alloy blanks made on another machine were placed in a vertical tube in front of the machine and fed from the bottom one at a time to a position directly under the vertically reciprocating slide which held a tool to operate on one side of the blank while a similar tool in the base operated on the other side. The blanks cost about 1/10 cent each, labor and material, and after being operated on were worth 25 cents. There was quite a demand for these goods until a secret-service agent butted into the game. The story of what happened is long, but No. 946 at Sing Sing will tell it to you for a plug of hard tobacco.

New York. E. A. DIXIE.

An Automatic Screw Machine Job

Under the above heading, at page 714, W. M. McKenzie has shown a piece of unusual proportions which is rendered more difficult by the flange being on both ends. I was surprised that the production obtained was only 300 pieces in 10 hours. The diameter of the stock used was 0.875 inch, the spindle speed was 1200 revolutions per minute; using the formula 0.2618 × diameter in inches × revolutions per minute = surface speed per minute, we have 0.2618 × 0.875 × 1200, or 275 feet per minute. I think that 275 feet per minute (for ⅞ stock) is "going some," even for brass.



TOOLS FOR AN AUTOMATIC SCREW MACHINE JOB

In the above-mentioned article the stock is not fed to a stop, consequently the width of the flanges will vary. Let us suppose that on the width of these flanges we have 0.002 inch limit. Mr. McKenzie would then have substituted a stop for one of the drills; in the order of operations given below I have made it possible to use the stop and both drills. I have selected my feeds and speeds from tables given in the American Machinists' Handbook, and have made use of them ever since they first appeared in the American Machinist; by their use I obtain a maximum production and find that they are conservative in regard to tools.

Following is a comparison showing how I varied the feeds and speeds to suit conditions: Selecting from the tables for brass we have: Drill ¼ inch diameter, 0.0058 inch feed, 175 feet per minute speed. From 1½ inches wide, ⅜ inch smallest diameter, 0.0007 inch feed, 175 feet per minute speed, ream ¼ inch diameter, 0.007 inch feed, remove on diameter 0.006 inch, 130 feet per minute speed. I have used the following: Drill 0.242 inch diameter, 0.0069 inch feed, 76 feet per minute speed. Form 1½ inches wide, ⅜ inch smallest 137 feet per minute speed. Form 1 7/16 inches wide, 0.0007 feed, 176 feet per minute speed. Ream 0.249 inch diameter, 0.008 inch feed, remove on diameter 0.007 inch, 78 feet per minute speed. The order of operations is shown in the accompanying table.

This gives a product of 600 in 10 hours, which could be increased by the use of the high-speed drilling attachment. We are given no limits on the diameter of the hole and 0.003 inch limit on the body; as the pilot support is apt to wear the hole a couple of thousandths large, we use it in the drilled hole and ream after forming. Owing to the diameter of the cam roll it is usually the custom to allow not less than 0.03 of the cam to feed the stock or revolve the turret, but in some cases by cutting down the lead cam the proper distance, 0.025 will be sufficient. In this case 0.025 is equal to 30 revolutions of the spindle, or 1½ seconds. The turret can be revolved or the stock fed in 1 second.

	600 Revolutions per Minute.	1200 Revolutions per Minute.	Hundredths of Cam Surface.
Revolve turret		30	2½
Center and face 0.085" throw at 0.0047" feed		18	1½
Revolve turret		30	2½
Drill 1" throw at 0.0069" feed		144	12
Withdraw drill for oil		24	2
Drill 0.440" throw at 0.0061" feed		72	6
Form (slow speed) with cutter A, 0.158" throw at 0.0008" feed	198	396	33
(Revolve turret and support with pilot *B* while forming)	(198)	(396)	(33)
Form 0.109" throw at 0.0007" feed		156	13
(Support with pilot)		(156)	(13)
(Cut off while forming 0.170" throw at 0.0009" feed)	(198)	(396)	(33)
Revolve turret		30	2½
Ream 1.44" throw at 0.008" feed		180	15
Finish cutting off 0.173" throw at 0.0019" feed		90	7½
(Revolve turret 2 times while cutting off)		(60)	(5)
Feed stock to stop		30	2½
Total number of revolutions of the spindle to make one piece		1200	100

It will be noticed that I have used only one drill; this leaves an empty hole in the turret to allow space for the slotting arm to descend. By removing the saw I can use the slotting attachment for separating the work from the chips. My experience has been that the wide form tools pile up the chips in spite of the deflector; of course, where there are only one or two screw machines the operator could keep the chips clear, but where there are 6 to 10 machines for one operator it would pay to automatically pick out the work. The pilot *C* is used to enter the hole instead of the usual slotting bushing which grasps the outside of the piece.

The following order of operations shows how Mr. McKenzie could have used the support which he preferred, also the box tool and two drills and still feed to a stop. Feed stock first time; center and true up stock; feed stock second time to stop *D*; form while supporting with *E*; drill; ream; use box tool. With this last method the piece could be drilled and reamed before forming instead of after, if it is thought necessary.

Ilion, N. Y. Don-Nevin.

Comment on Mr. Baldwin's Story

The story which Mr. Baldwin quotes at page 678 reminds me of a little experience of my own. A few years ago I was waiting around for a job to materialize. Waiting is always slow work and I was financially on my uppers, so instead of going around and begging for advance pay I looked about for a job. I happened to find a shop, that had been shut down and the machinery sold off, where there was a planer which had been left by the purchaser. I also found that the owners of the building wanted to have the machine moved so I offered to get the thing on the cars for $40, which was not so very much when you consider that the planer had a 20-foot table and that it set in a pit with the top of the platen nearly down to the floor level. I had nothing to work with except an old hydraulic jack that had lost about half its run and a few rolls and a miscellaneous lot of scraps of lumber. The bed of the machine was in three pieces, the center part being 30 feet long. The two end pins I unbolted and got out without much trouble. The center part was so heavy that I could hardly lift one end with the jack. I put on all steam on the jack and then drove wedges till I had one end up enough to slide a board under the bed up half way to the housings. Then I went to the other end and found that I could lift it there as it was partially balanced on the board. I went back and forth getting first one inch, then two, then three on each end and gradually building

up a cob house under the housings till I had it enough above the floor to get the skids under and then the rolls. The rolls projected over onto the floor each side of the planer pit except under the housings where I had to be very careful to keep them close to the edges of the hole in the floor.

The next thing was to pull it along the floor. No pry that I could get would budge it an inch. I hitched onto a traveling crane with a two-ton hand hoist in the next bay and pulled up on the hoist with all my weight. No movement. Then I hung on chains as it sloped up from the planer. By jumping on it I started it and inch by inch drew that planer single handed out to the door of the shop.

A local trucking concern offered to take the machine from there and load it on the cars for $15 and attach the $40 to the expense on the bill of lading, so I netted $25 for just exactly 24 hours' work. A dollar an hour for laboring! What do you say boys, who wouldn't be a laborer? The trouble with most young men when they get down and out is that they disdain jobs that they can get because there is not money enough in them. There is money in anything that a man knows how to do provided he is not too sure that he possesses every last bit of knowledge how to do it, and refuses to think for himself. I knew the proper way to do that job was to go and get a moving gang with jacks and blocks, etc., and pay them $45 out of my $40 to do it and watch them stand around all day while one man out of the bunch practically did the whole thing.

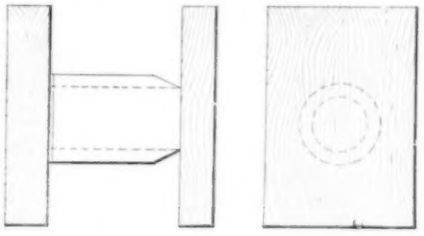
In Mr. Baldwin's story the whole thing hinged on this young man finding a foreman who would give him a six-cent job. If that particular foreman had had a cross word from his wife before he went to work that day the story never would have been told. What our boys need is not advice to work, but advice how to get a job and how to know a good one when they have gotten it. There is no sense in an able-bodied man with his just amount of brains working for the going wage. There are mighty few jobs where a proprietor would not gladly pay a man twice the going wage if he would do three times the work that his men had adopted as a standard. Call it scabbing the job if you will. Every great name in the world's history is that of a scab. The independent young man who will do his best to do a real day's work and then insist on being paid somewhere near what he earns can by and by command a position where he can afford to be called by any number of hard names.

I am rather inclined to take a more optimistic view of the boys of today than Mr. Baldwin does. They would be glad to take hold and show the stuff that is in them, but no one that is in the swim is willing to stop and tell them how. A boy may want to be a machinist, but no one will show him the ropes, no one will tell him how to get into a shop to work. He reads a story about a boy who simply walked in and went to work and in five or ten minutes won his way to his employer's heart and over near the bottom of the third page he marries the treasurer's daughter, and he thinks it is all tommyrot and he usually has sense enough to avoid any grand-stand play. The fact is that a boy doesn't get much of a chance to find out what he does want to do. If his father is a machinist, no matter how good, he will likely want the boy to be a plumber or a lawyer. The reason why is just because he does not know anything about these jobs himself. The boy is up against the alternative. He probably thinks that he would be a better fit playing third base on the New Yorks, so he tries the plumbing and burns his hands and gets laughed at and the boss tells him he is too awkward to ever be a workman of any kind. Then he tries sweeping out a law office and puts somebody's deeds in the waste basket and it's all off and he shifts around from pillar to post getting kicked every time just because there is no kind and sympathetic foreman with a beautiful daughter outside the story books.

Worcester, Mass. ENTROPY.

Contraction and Expansion in Hardening

I do not know that I can save Mr. Toot the sleepless nights that he fears are to come from the action of the steel referred to in his articles, on page 753, entitled, "Two Heat Shrinks," but this class of work comes under my observation most every day, and it is a subject that must be handled with care. We must not allow steel to expand in the hardening except under given conditions. To do so the hardening room would become expensive and get the best of the hardener. Then we must know why the collar that Mr. Toot refers to expanded.



CONTRACTING A BUSHING

Let us take a very thin collar or bushing and harden it without shrinking it on a shaft. We will find that invariably it is from 0.001 to 0.002 inch larger. Then we take a heavier collar or bushing and harden that, and unless there is a stream of water forced through the hole in the hardening, it will get from 0.001 to 0.002 inch smaller. Then take the same bushing and harden it by forcing the water through the hole and the bushing will expand.

Now let us see why this is. If the bushing is thin, in the hardening which takes place from both inside and out, it hardens entirely through and in so doing it has sufficient strength, or heat, to stave itself up, which it actually does when it gets smaller. With the heavier bushing that is hardened, the hardening, of course, takes place both inside and out, but it cools off first from the outside, and the time required for cooling is greater than in the smaller bushing. There is more heat left in the heavy bushing after it is hardened than there is in the smaller bushing; consequently, it staves itself up by its own force.

The difference in the two bushings would be that, if broken and tested with the scleroscope, the small piece would be found uniform throughout while the heavier piece would be found to vary at the center, or where the cooling left off from each side. If it were possible to cool the larger bushing as rapidly as the smaller one, and produce the same hardness through the piece, then we could expect the same results from each piece. But we cannot cool a large bushing as quickly as we can a small one, therefore we get different results. A bushing that expands in the hardening is under a greater strain than the bushing that shows that distortion has taken place.

There is also one other reason for steel expanding in the hardening and that is the heat given the steel. I have hardened some very delicate tools, the side walls of which were 0.01563 inch thick and 0.925 inch long, and I find that they expand from 0.001 to 0.002 inch, and if heated 15 degrees higher there will be a distortion of from 0.0001 to 0.0002 inch. This is not a matter of a few trials, but it is the actual result obtained daily.

As to why the collar that Mr. Toot refers to expanded, we are certain that this collar was not cooled from the inside, also that if he had waited a few seconds longer he would have had his collar shrunk on and soft at that. He no doubt plunged it in the water at a very low heat or within a few degrees of the lowest heat that the steel would harden at, which is the heat at which we find that steel will expand.

Again, it could be that the outside hardened sufficiently deep to withstand the force of distortion left in the piece after it ceased to harden (not ceased to cool). If he had made his collar the same size as the shafting and depended on the distortion of the collar to hold it in place, as was the condition when he put it on the second time, and had he dipped it when the heat was just 15 degrees higher, then he would have it both hard and fast.

In order to prove the above, take a collar or bushing that is heated to the hardening heat and place it between two pieces of a board, as is shown in the line cut, and plunge the whole in water to cool. It will

be found considerably smaller than before hardening. Then take a thin bushing; heat it to the hardening heat; place it inside of another bushing, with a thrust screw to hold the small bushing in place, thus preventing the water from striking the outside in cooling, and cool as quickly as possible by forcing the water through the hole. This bushing will be found considerably larger.

St. Louis, Mo. JAMES STEELE.

The Hindley Worm and Wheel

The demonstration of the Hindley worm gear by Mr. Beale, on page 480, Vol. 31, Part 2, is quite interesting. It proves the fact that such a worm gear will mesh perfectly on the center line, or midplane, but away from the midplane it will work intermittently unless the worm is too long, in which case it will ride on the points of the outside pair of teeth and not touch at the center at all.

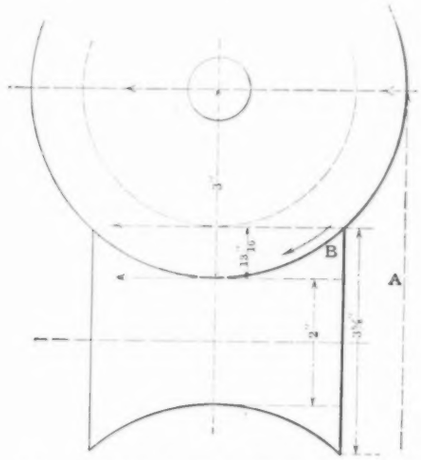


FIG. 1. DIAGRAM OF HINDLEY WORM AND WHEEL

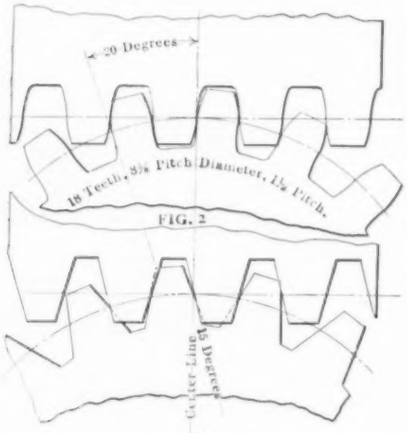


FIG. 2

FIG. 3
SECTION OF A HINDLEY WORM AND A WORM WITH A V-TOOTH

In the analysis of the Hindley gear we find the delivery of the force to be along the tangent line, in the same way as a belt would transmit it, as shown in Fig. 1. The worm in all its parts drives parallel with its axis, but the wheel moves in the same direction only at the junction of the tangent with the center line; the motion at that point is harmonious. At the ends of the worm the line of motion is out of harmony with the driving force; the circumferential motion of the wheel decreased in proportion to its declination from the straight line. If the worm were extended to the line *A* its last thread would act upon the dead center of the wheel and the driving force would be entirely lost at that point. If the threads of the worm were cut away except at the ends the effect would be the same as with a straight worm of the large diameter and a wheel reduced in diameter. The leverage of the wheel would be reduced by 13/16 inch, and the resistance at the tangent increased in the same proportion. Thus, we find the least circumferential velocity of the worm at the center line producing the greatest effect upon the wheel with the least friction, and the greatest circumferential velocity of the worm with the greatest friction at the ends producing a reduced effect upon the wheel.

The worm gear involves peculiarities of construction not found in any other gear. At a sectional line through the center it shows the principles of the rack and gear, as shown in Fig. 2; the lines of approach, contact and recedence, are identical, but in place of the linear motion of the rack the worm has a rotary motion, as it is stationary in its bearings and advances the teeth of the gear through its thread. While the fit is perfect in the center, it is entirely different away from the center.

To illustrate this I present the drawings of worm gears which are used to move the portable towers of several elevators in the harbor of Buffalo (see Fig. 4). The gear is 2¾ pitch, 6¼-inch face, with 30 teeth. The worm is 9⅝ inches outside diameter and 8⅛ pitch diameter. The normal pitch diameter of the wheel is 26½ inches and the high-pitch diameter is 28⅛ inches. The radiation in the gear is 12 degrees. The drawing is an outside view and the teeth on the center line are drawn in short dashes. As the normal pitch line is the base of the swing, it follows that the swing increases with the distance away from the center. This, in conjunction with the increase in the pitch above the normal pitch line, is bound to interfere with the worm whose pitch remains normal at all points. The teeth must be modified away from the midplane to keep them within the normal pitch at their highest points with the result that they gradually disappear in a sharp edge if carried to the limit.

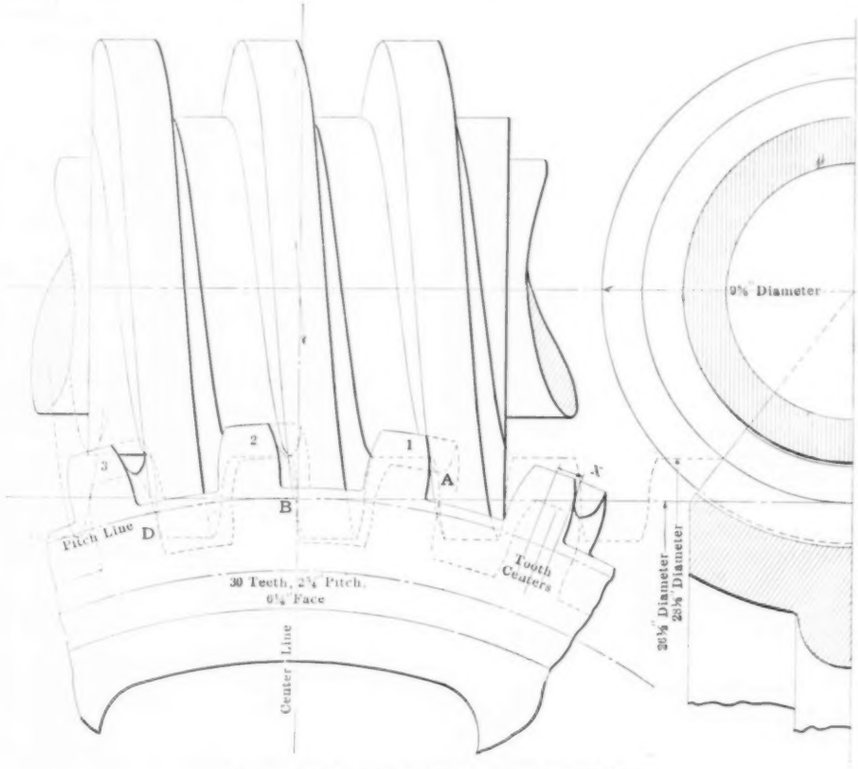


FIG. 4. WORM AND GEARS USED ON ELEVATORS

The face of the tooth 1 is reduced so as to bear against the worm from its highest point to the normal pitch line at *A*. Tooth 2 has swung into a central position at its point, but is in contact at the pitch line at *B*. Tooth 3 has swung to the opposite position of tooth 1, just clearing the worm in going out of action at its highest point, but still driving below the pitch line at *D*. A thread added to the worm at each end would interfere, as shown at *X* and 3, and would prevent the worm from

going into its position at all. The shortest worm of largest diameter with narrowest face of wheel makes the best fit, and the designer should hold these proportions within reasonable limits.

The epicycloid form of tooth gives the greatest wearing surface, but the involute is easier of construction. The practice of making the worm a simple V-thread is bad, as such teeth cannot work without interfering, as shown in Fig. 3, in which the sides of all teeth are made with an angle of 15 degrees. Only by keeping them some distance apart can they be made to work at all. With a flat V-thread in the worm the modification must be made entirely in the wheel, resulting in short convex surfaces wearing upon flat surfaces, leaving considerable surface unused, and a weak tooth at the root in the gear.

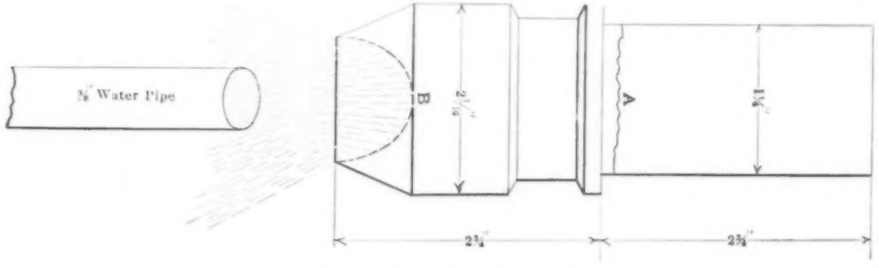
Buffalo, N. Y. F. M. SCHORN.

Hardening Rivet Snaps

There may be a great many users of pneumatic hammers having the troubles of Mr. Tyneside that he speaks of on page 753, Vol. 31. I do not see how he can harden a snap as large as the one shown in oil. He can, of course, cool it in oil, but surely he does not want us to think that the snap is hard after being cooled in oil. Therefore, it will be necessary for him to discontinue the use of oil in the hardening before he can have any success in using them. There are but few ways of hardening these snaps, and he will have but few to choose from. First, if a snap is for any ordinary use it should be hardened, as is shown in the accompanying sketch, heating the entire tool to the hardening heat, then holding it directly over a small stream of water with plenty of force to it, being careful not to allow the water to strike any part of the tool except the cap part at *B*. Hold over the stream and continue to cool until the shank is black, then polish and draw to the desired temper. If the hammer is to be put to the severest use then the tool should be treated as follows: Heat the entire tool to the hardening heat, place over a stream of water, as is shown in the sketch, except that the pipe should be under water to a sufficient depth to permit the submerging of the entire tool, thus hardening shank and all, but being careful to keep the stream of water entering the cap *B* until the tool is cool. Then take from the water and polish to draw. A hammer snap hardened in this way should always be drawn in lead, having the lead 700 degrees Fahrenheit, then place the shank of the tool in the lead up to the point *A*, where it broke with Mr. Tyneside; leave in the lead until the cap *B* is drawn to the desired temper, then cool to check the temper.

A hammer hardened in this way, if properly heated, will be found in the following condition: There will be no trace of the shank ever being hardened when tested with a file, but if broken, the steel should be very fine and silky and be extremely tough, in fact it will be in the best possible condition for a tool where a severe shock is continuous as it is in the pneumatic hammer.

Davenport, Iowa. JAMES STEELE.



HARDENING RIVET SNAPS

Selection of Grinding Wheels

The trouble of your correspondent, L. F. C. George, is a problem that has also presented itself to others. The advice given by makers of wheels and machines is in many cases diametrically opposed, and when doctors disagree what is to be done? To commence a series of experiments oneself is the only alternative and this need not be a costly affair if carried out as follows: One foreman's order book is set aside solely for grinding wheels and is kept by the leading operator. Whenever a new wheel is ordered from the store the ticket, which is found attached to most makes of wheels, containing the necessary reference number, grade, etc., is pinned to the duplicate; there is plenty of room on the back of the duplicate order for the operator to write a report of the behavior of the said wheel under various conditions, such as diameter of work, speed of wheel, speed of work, etc. One may safely assume that if the operator is working under a premium or piecework system the information given will be of a reliable character; the former also periodically examines the book and sees that the thing is kept uptodate.

With this system a collection of valuable data is soon gathered, which covers the range of work under shop conditions. Useless brands of wheels are soon eliminated to be replaced by a fresh brand, and by a process of evolution, the last wheels are eventually chosen. Some of your readers may say that this is rather a slow way, but at any rate it is thorough, and prevents practically useless wheels being ordered over and over again as I know is frequently done in more than one shop. This system incidentally furnishes much more information and shows up plainly where and how, and by whom the wheels have been used, being a check on carelessness and a too liberal use of the diamond.

It is certainly a fact that the wheels which run so successfully on Jones' machine, do not prove the same on Smith's machine. This is probably due to one machine being of more rigid construction than the other; the speeds may also differ, both of the wheel and of the work. With all these conditions so variable it is not to be wondered at that the information given is of so little value. I find that wheels suitable for diameters of, say, 4 inches, are of no use on small diameters of about ⅝ of the same material, and this is only one of a vast number of facts which at first sight one would hardly find. Similar actions give similar effects or cause and effects are equal and opposite. What we have to do is to collect the data lying around us, and then it will be possible to draw some conclusions, and be able to select one's own wheels without relying on what the maker's representative tells us, and with some degree of confidence in the result.

B. ARLINGTON.

Toddington, England.

Cutting a 20-inch Gear on a 10-inch Dividing Head

Under the above heading, on page 641, the following statement appears: "An angle plate was fastened to the table of the milling machine. To this angle plate the dividing head was fastened." Now this does not seem very clear to me why he should fasten the dividing head to an angle plate to bring the spindle into a vertical position.

In the shop where I am employed we have cut gears as large as 3 ft. diameter on a Brown & Sharpe No. 3 universal. Our way is to turn the dividing-head spindle into its vertical position. Screw a face plate (with plenty of holes in for bolts) onto the end of the spindle. An arbor about 2 inches diameter is fitted into the spindle, which stands out about 6 inches from the face plate. We have loose bushings to fit the bore of the wheels made to slip over the arbor. This centers the blank, which is then bolted down to the face plate. Two jacks are then put under, one on each side of the cut. Our machine not having a vertical

feed, we traverse by a ½-inch belt, off a 3-inch pulley fixed on the end of the cutter spindle, onto a 2-foot wooden pulley fixed on the hand wheel, used for operating the knee. We cut gears up to 4 pitch, using one cutter, going once around. Above 4 pitch we use two cutters side by side, one roughing and one finishing.

Birmingham, England. C. R.

[There are dividing heads which do not swivel; this may have been one of them. An angle plate may have been used to increase the range of the milling machine. —Ed.]

Things That Are Usually Wrong—Fitting Steady Pins in Engine Cylinder Feet

Having read with interest Professor Sweet's articles at different times in the

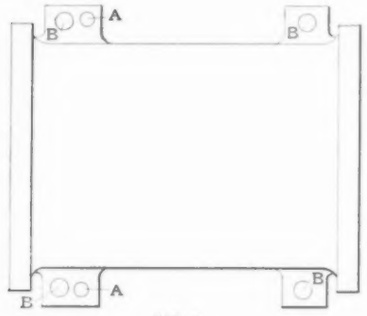


FIG. 1

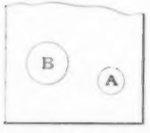


FIG. 2

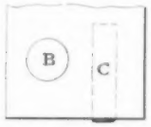


FIG. 3

FIG. 4

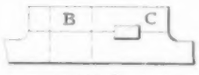


FIG. 5

FITTING STEADY PINS IN ENGINE CYLINDER FEET

American Machinist on "Things which are generally wrong," an interesting case came to my notice some time ago.

A large and prosperous firm of heavy engine builders who had been established about 40 years, had booked a contract to build some 350-horsepower slow-speed horizontal compound Corliss engines, which had to be inspected by the chief engineer of one of the leading engine and boiler insurance companies before being taken over by the purchasers. This inspector came to see that all was in order as we were completing the engines in the works, and one of the erectors was commencing to drill the holes for the steady pins in the front feet of the cylinder and bedplate, as shown at *A* in Fig. 1, which is a plan of the cylinder, minus the valve chests. *B* are the holes cored through the cylinder feet and also in the bed for the foundation bolts to pass through. The steady-pin holes are drilled through the front feet only, so that the cylinder can expand more than the bed, and the back feet are free to float, under the pressure of the foundation bolts, of course. When the inspector saw us fixing the pneumatic drill up to drill and ream the holes, he asked what we were going to do. The manager informed him we were going to fit the steady pins in the cylinder feet, but he remonstrated and stopped the method of procedure. Fig. 2 shows a plan and Fig. 4 a side elevation of our usual method which we had carried out for 40 years, but to our surprise he would have none of it, and made us fit keys instead, as shown at Fig. 3 in plan, and Fig. 5 in elevation, *C* being the key. The firm did not think much of his improved method, and we found they were much more expensive to fit, having to be fitted by hand the same as a key. After much arguing we saw that his method was much better, and we have adopted it as our standard, for the following very good reasons: These steadies are subjected to a shearing strain only, when the engine is working, the foundation bolts holding the cylinder down on its bed. The pins we were going to fit in this case were 1.75 inches diameter, which would give a sectional area of 2.4052 square inches to shear off, whereas we fitted two keys instead, each being 1.25 inches wide by 4 inches long and 0.75 inch thick, which would give a sectional area of 5 square inches per key, or more than twice that of the round pins.

We came to the conclusion that although we had been fitting round pins for 40 years and never had any complaint before, we had been carrying out one of "the things that are generally wrong."

Leeds, England. Engineer.

Hardening Pneumatic Hammer Snaps

As Tynesider states his difficulty in hardening pneumatic rivet snaps on page 753, I would suggest that he harden them all over and then draw the temper from the shank to a dark straw color.

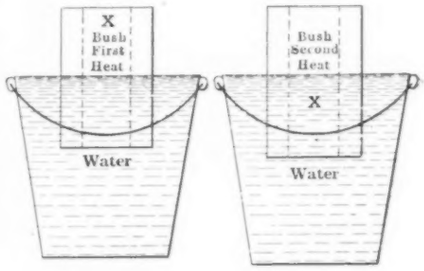
We have had the same trouble he is having and have also been troubled with the sets or snaps cracking at the edge where cupped for the rivet. The greater part of our trouble was from trying to use a low carbon steel for which we paid about 15c. It was absolutely impossible to get results from this cheap steel. We tried in succession hardening in oil, clear water, brine, chilling in water, then plunging in oil, changed from gas furnace to charcoal fire but with the same results in each case.

We took the matter up with one of the large steel plants and they sent one of their experts to go over the situation but he could not do anything with this cheap steel. We then bought a better grade at about 25c. which was perfectly satisfactory, but we continued to harden in water, polish, and draw in oil. By hardening the snap all over, the shank does not batter up and stick in the cylinder as is sometimes the case when the cupped end only is hardened.

Dayton, O. Hammer.

Cause of Two Heat Shrinks

In reply to T. Toot's article on page 753 in reference to shrinking a bush on a shaft, will say I have had considerable experience in the line of tempering cutters, tools, collars, etc., for milling machines. I have found on cutters and collars that every time they are heated, the hole will contract when cooled. For instance, take a cutter rod and heat it to anneal, then temper it and it will be found that the hole has shrunk to some extent, and will have to be lapped out to fit the



QUENCHING THE BUSHING

spindle. This would be the same in his case. If he should heat the collar again he would have trouble to get it on the shaft. The shrinkage depends on the size of the hole and the thickness of the stock. If the hole is large and the stock heavy, the shrinkage will be greater than if the stock is light and the hole small.

In a shop I had charge of some time ago, I gave a bushing to a machinist to bore so it would press on a shaft and be finished on it. The bush was 6 inches long, 6½ inches in diameter and 4-inch bore. He made a miss in calipering the fit, and the bushing would tap on with a light hammer and they thought it lost. The job was in a hurry and the superintendent was not a very pleasant man if things went wrong. When he went away at noon I took the bush in the forge shop and heated it to a cherry red and immersed it in water, as shown in the line cut. First it was quenched with the X mark up, then heated again and quenched with the X mark down. After it got cold we tried it, and found it had to be forced on the shaft with a 5-ton press.

The hole will not be exactly round, but it will be the means of saving a good many jobs that might have to be thrown away. If Mr. Toot will try this he will be surprised at the shrinkage of the hole and will find what caused his bush to fit the shaft.

Orange, N. J. S. J. KELLY.

Re-tiring Locomotive Wheels

Our original method for taking the tires off was to drop the wheels on end on a ring or band made of ¼-inch plate, of a diameter slightly less than the inside diameter of the tire and about 12 inches wide, so that the wheel center rested on the ring, and the crank pin was clear of the floor. A piece of 1-inch pipe bent to a circle about 3 inches greater in diameter than the outside of the tire, and punched with holes on its inside to act as a burner, was supplied with gas from a 2-inch pipe. This was the rig for heating the tire. No air coming through with the gas, a sooty deposit was at once formed, and the tire heated so slowly that the wheel center heated almost as rapidly as the tire, and the two expanding together made the job of shifting the tire a hard one. At times as many as eight helpers with sledge hammers persuaded the tire to come off, but occasionally this persuasive treatment failed, the tire then having to be drilled or slotted through. The tires usually burst with a loud report when cut in this way, giving one an idea of the immense strain in the metal. The tires when put on were heated in a large, open, coke fire, in which it was possible to make them red hot, so there was no difficulty in making them go on.

At last, the foreman, disgusted with many tight tires in succession, had the rig altered and tried with perfect success, both for putting on and taking off the tires. A gas ring of 1½-inch pipe was made about a foot larger than the largest tires used. Holes were drilled and tapped round the inside of the ring about 6 inches apart, in which were screwed 5-inch lengths of ½-inch pipe radial to the ring. A straight piece of pipe was connected to the ring, and a T-piece made connection with a small blower. The wheels were dropped on the ring or band first described; the burner ring was packed up so the gas flame played on the tread of the tire, and the blower turned on. The resulting flame was perfect; a cock on the blower pipe allowing the blast to be adjusted to a nicety.

About 20 minutes heated a tire sufficiently for two helpers to tap it off with hammers. It was very rarely that the full orchestra of eight were called on with the new burner in use. To put the tires on, two old guide bars were laid across the ring or anvil, the tire laid flat on top and the gas turned on. A gage tested the amount of expansion and at the right time the wheels suspended from the gantry were brought over and the center dropped in the tire. A pail of water ladled on cooled the tire sufficiently to grip, so that the other wheel could be operated on. Two men with this rig could easily tire six wheels in the day of nine hours.

London, Eng. NEMO.

Experiments with Barium Chloride for Hardening

It is with interest that I note what my brother hardeners have to say in regard to the use of barium chloride for heating high-speed steel. Several months ago in an article in the monthly AMERICAN MACHINIST I stated that I could not as yet recommend barium chloride in preference to gas and I cannot do so today.

Some claim that high-speed steel does not warp, and does not lose its size, when heated in barium chloride. Such results I have utterly failed to produce and get the best results from the steel, but I can do it by not bringing the steel up to its proper hardening heat. A high-speed tool can be brought up to 2100 degrees Fahrenheit in barium chloride, without pitting, and it will do some kinds of work very nicely, in fact better than carbon steel, but it will not do the work of a tool brought up to the proper heat for hardening.

I have done considerable experimenting with barium chloride and I have found two ways of using it. One way is to make an attachment of a gas pipe, to hold about 2 lb. of barium chloride, by putting on a valve and attaching this to the air and gas mixer directly outside of the furnace, where the burners enter. Then when the tool warms up to, say, 2000 degrees Fahrenheit, I open the valves on either side to allow the barium chloride to enter with the air and gas, thus coating the tool as well as the inside of the furnace. When the tool is nearing the desired heat, I again open the valve and let the barium chloride again pass into the furnace to coat the tool the second time. Then I immediately remove the tool from the fire and quench it in oil. This can only be done with a furnace with common gas pipe for burners, as the regular burner will clog up.

I have also placed the attachment in the vent of the furnace and by placing the work directly under the vent, I am able to coat the tool thoroughly and bring the work out free from pits and blisters. This would prove that there is nothing in the barium chloride that blisters the steel, but rather that it is some foreign matter.

While I have tried to note some improvement in tools treated in this manner I have not been able to do so. This again proves the theory that no matter how high-speed steel is heated and cooled, the hardness and durability depend entirely on the amount of heat given the tool, whether it be heated in barium chloride, gas or electricity, or cooled in oil or red-hot cyanide.

The barium chloride is a bad material to have in the shop, both for man and machinery. Its fumes can be traced for a block through the shop and it has a very peculiar effect on the teeth, having a tendency to soften them, while they will eat into most anything that contains iron. If any particle is left on a tool after hardening it will soon demonstrate its ability in this respect.

It has been my experience that high-speed steel heated in a properly constructed gas furnace, to 2100 degrees Fahrenheit, will hold its size as completely as will a tool heated in barium chloride to the same heat. Consequently I do not see anything to be gained by using the barium bath. In fact I think that it will be discontinued entirely, in the near future, except where it is heated by fused electroids.

There is another process of bringing high-speed steel clean from the hardening and it is much less injurious to both man and machinery. That is by using a cyanide cooling bath. Of course, the fumes from the cyanide are very injurious, but the heat carried on the cyanide should not be more than 1400 degrees Fahrenheit. It is much easier to control the fumes from a cyanide bath at this heat, than it is a barium bath at 2100 degrees Fahrenheit.

With the cyanide bath the steel or tool is brought to the regular hardening heat, then taken from the high-heated furnace and plunged in the cyanide bath. The bath can be from 800 to 1400 degrees Fahrenheit, and as soon as the steel or tool is cooled to the heat of the cyanide bath, it should be removed and placed in oil and allowed to cool. Tools treated in this manner will not need to be drawn and will be clean and free from scales and pits, unless scaled and pitted in the hardening heat.

After making all the tests mentioned above and giving them a fair trial, we have again turned to the gas fire and have concluded that while some may find it necessary and profitable to use barium and cyanide we much prefer the gas. With it we are able to give our steel the desired heat and bring it from the fire free from pits and scales. If the tool is sprung, we place it across a lead block, with the high side up, and strike it lightly with a lead hammer. We can in this way get the tools perfectly straight even though they be cold. In fact this is the way we straighten all of our work. It requires but very little time and the loss is practically nothing. The reader will bear in mind that we use high-speed steel for all kinds of tools, even for engraving tools and wood tools.

Dubuque, Iowa. JAMES STEELE.

Heavy Slab and Vertical Milling Machine

By I. W. Chubb

A heavy type slab-milling machine constructed recently by Sir W. G. Armstrong, Whitworth & Co., Ltd., Manchester, is shown in Fig. 1. It will handle face milling, locomotive connecting rods, or similar classes of work. The machine is driven by a 40-horsepower variable-speed motor placed at the back, and will remove 30 cubic inches of metal a minute. The table is 2 feet wide by 14 feet long. The motor drives through horizontal shaft and bevel gearing to a pinion which gears direct into the wheel on the left-hand end of the spindle. This wheel has a cast-iron center and a forged-steel rim with single helical machine-cut teeth, and the pinion is of forged steel, case-hardened. The cutter mandrel is let into a coned hole in the main spindle and is supported at the outer end by a bracket, while a middle bracket supports the spindle when two cutters are used, as in milling locomotive connecting rods.

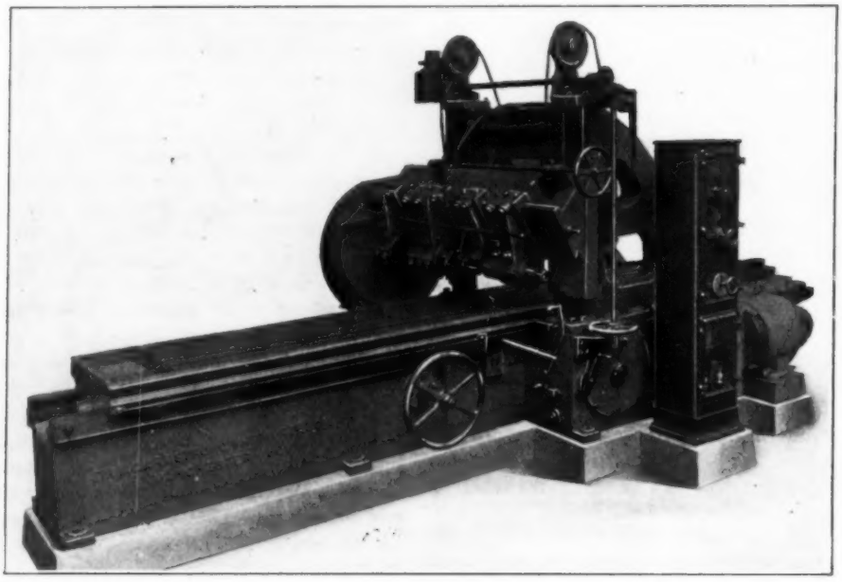


FIG. 1. SLAB-MILLING MACHINE WITH TWO MOTORS

The spindle speeds range from 25 to 75 revolutions per minute, and the table feeds from 2 to 12 inches per minute with a quick movement of the table along the bed in either direction, is provided at the rate of 12 feet per minute. Both the feeds and quick run are obtained through gearing changes from a second motor, also of the variable-speed type, which can be seen. The movement of the table can be stopped by the lever which projects in front of the upright, and the hand wheel is for finer adjustment. The cross-slide can be moved up or down the face of the upright either by hand or by self-acting gear controlled by clutch, the lever being placed at the top above the upright. Both table and cross-slides bear brass plates marked in ⅛ inch so as to indicate position, pointers being attached to the bed, and adjustable stops are fitted to the table so that the feeds can be thrown in or out at any position. The box in front of the machine contains the starting switch and regulating switches for the two motors, and the usual automatic releases, the equipment being arranged so that both motors stop simultaneously.

A similar machine in which, however, a single motor is used, is shown in Fig. 2. The feed and quick return are here obtained from gearing and clutches.

A vertical milling machine by the same firm with a two-motor drive, one for the spindle and the other for the feed, is shown in Fig. 3. The main-drive motor is carried on top of the upright and the feed motor is on the base at the back of the upright. As both are of the variable-speed type, the spindle can be run at a speed suitable for the cutter and similarly the feed can be suited to the work. The panel attached to the base of the machine contains a starting switch, a regulating switch for the main drive and a switch for the feed motor. The gear box on the upright, next to the switch frame, together with the variation of speed in the motor, give a range of feeds up to 12 inches per minute.

The connection for the longitudinal and circular feeds is by clutches controlled by levers, and trip motion is provided to all the feeds. Here again the two motors are electrically interconnected so that the feed cannot run while the spindle is stopped. This is managed by the simple expedient of having only one double-pole switch, one set of fuses, and one starting switch for both motors. Should, therefore, the main switch be opened, or the fuses melt, both motors must stop together. The capacity of this machine is as follows: Spindle, 3½ inches diameter; center of spindle to inside face of frame, 24 inches; vertical traverse of spindle, 12 inches; longitudinal traverse of table, 36 inches; transverse movement of table, 30 inches, and diameter of table, 30 inches.

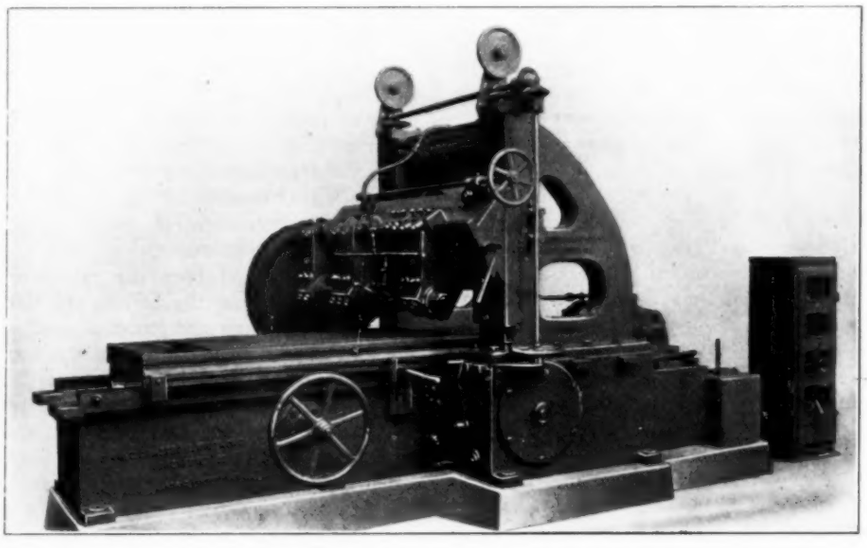


FIG. 2. A SINGLE-MOTOR MILLING MACHINE

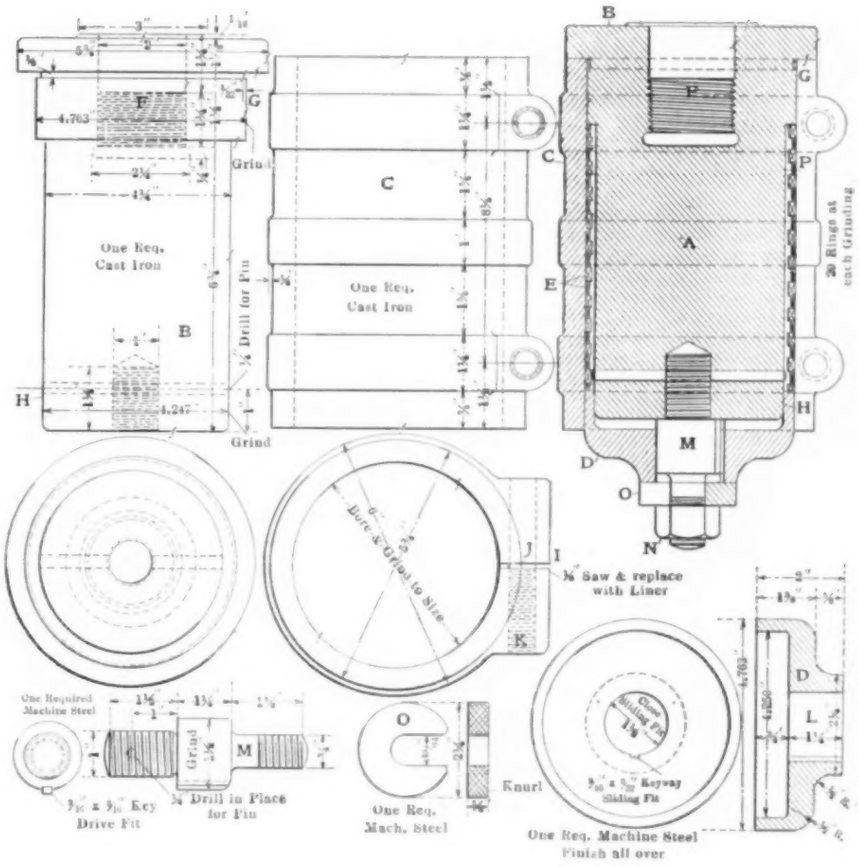
The exportation of automobiles and parts from the United States for the fiscal year ending June 30, 1908, amounted to $5,277,847, against $5,502,241 the previous twelve months. While this is a slight decrease it is encouraging to note that during the calendar year of 1907 there were produced in this country 52,000 motor cars, with a value of $105,000,000, whereas for the year 1903 the sales only reached $8,000,000.

Piston Ring Grinding Fixture

By R. B. Lovejoy

I have noticed several articles at various times in the American Machinist concerning fixtures for grinding piston rings. The fixture shown herewith was designed especially for automobile piston rings, but there is no reason why the idea will not be practical for any kind of ring.

The fixture is shown assembled at *A*. It consists essentially of a spindle *B*, a removable cylinder *C*, and a pusher *D*. Twenty rings 3/8 of an inch wide are ground on the fixture at each setting, in the following manner: After being slotted and rough-turned inside and out, the rings are compressed by hand and shoved into the cylinder *C* until twenty are inserted. This cylinder, containing the compressed rings, is then slid onto the spindle *B*, and the pusher *D* is screwed up tight against the rings by the nut *N*. The collar screws in the tapped holes *K* are then loosened, and the cylinder is removed, leaving the rings held tightly on the spindle by the pusher. The rings touch only at their sides and stand clear of the spindle on their inside diameter. It is a good idea to put the rings into the cylinder so their thick and thin sides will alternate as shown at *E*. After grinding, the rings are quickly removed by loosening the nut *N* and pulling the pusher *D* over the nut by removing the split washer *O*.



DETAILS OF JIG FOR GRINDING 20 PISTON RINGS

Concerning the construction of the fixture, the following suggestions may well be noted:

The spindle *B* is made of cast iron. It fits the thread of the spindle on the grinder at *F*. It is ground to fit the inside diameter of the cylinder *C*, at *G* and the inside diameter of the pusher *D* at *H*. To secure the best results, all grinding done in making the fixture should be done on the spindle on which the fixture will be used. The diameter of the spindle *B* at *P* should be less than the inside diameter of the rings to be ground, so as to allow them to clear it entirely.

The cylinder *C* is also cast iron, its inside diameter being ground to fit the outside diameter of the spindle and the pusher. The cylinder is sawed at *I* and liners *J* are put in the slot so that exactly the required inside diameter may be attained by the thickness of the liners *J* and the collar screws in the tapped holes *K*. The inside diameter of this cylinder is the same as that of the engine cylinder in which the rings will work, plus twice the thickness of the stock left for grinding after the outside rough-turning is done.

The pusher *D* is made of machine steel. The hole *L* should be made large enough to slide over the nut *N* and the pin *M* should be a sliding fit in the hole *L*. The key keeps the pusher from turning with the nut *N*. Inserting the split washer *O* saves screwing the nut clear off after each grinding, and the time required for operating the fixture is considerably shortened thereby.

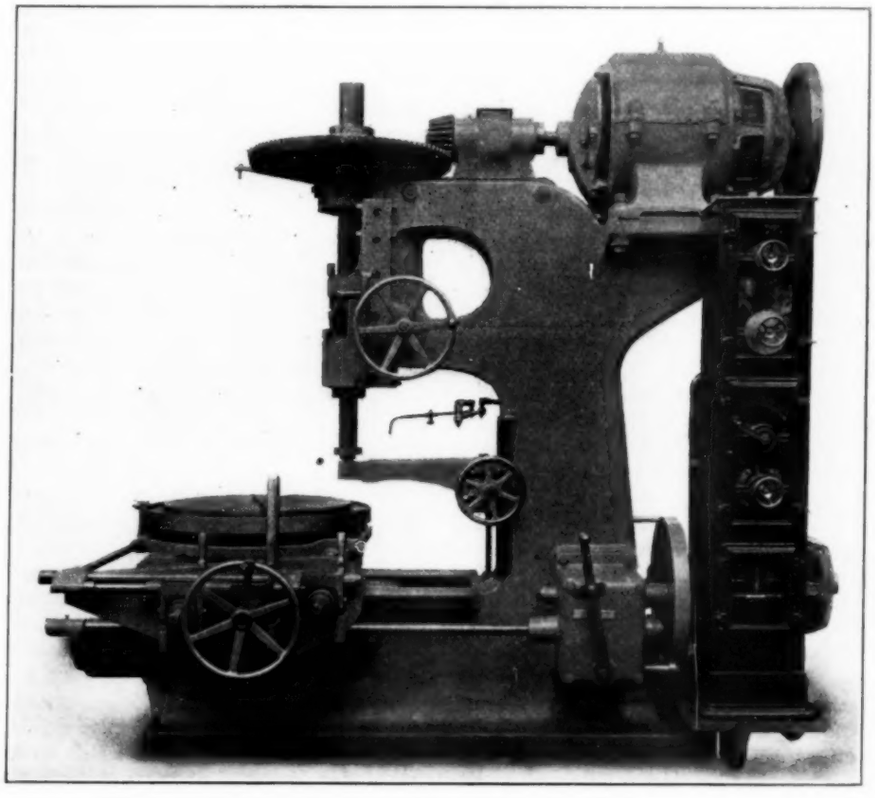


FIG. 3. HEAVY VERTICAL MILLING MACHINE

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

JOHN A. HILL, Pres. and Treas. ROBERT MCKEAN, Sec'y.

505 Pearl Street, New York.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Subscribers can have address changed at will. Give old and new addresses.

Subscription price $4 per year, postage prepaid, to any post office in United States, United States possessions and Mexico. $5.50 to Canada. $7 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

Hill Publishing Co., Ltd., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Business Telegraph Code.

CIRCULATION STATEMENT

During 1908 *we printed and circulated* 1,205,750 *copies of the* AMERICAN MACHINIST. *Our circulation for December,* 1908, *was (weekly, monthly and European)* 108,250.

January 7..... 34,750
January 14..... 19,500

This paper reaches 34,750 *separate readers each month and* 19,500 *each week.*

None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

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The Working of Patented Inventions

Our readers will recall the article by Dr. Alfred Muller, published on page 814, Part II, of our last year's volume, in which he outlined the action of last summer's Stockholm congress of the International Association for the Protection of Industrial Property, recommending that various countries should make special agreements between themselves on the lines of the one already existing between Germany and Italy, by the provisions of which the requirements for the compulsory working of patented inventions are waived. Doctor Muller also went on to give it as his personal opinion that "there is no doubt whatever that the present requirements of working of patented inventions will soon be a thing of the past."

A new phase of the subject is now opened, according to the *Times* of this city, by the drawing up of an agreement between Germany and this country, whereby each country binds itself not to exact compulsory working on the part of patentees residing in the other. According to the *Times*, the negotiations are substantially complete, the papers requiring little more than the necessary signatures, and it is expected that the negotiations will result in a definite treaty in the near future.

There can be no doubt that this matter has been brought to the fore by the action of Great Britain in incorporating a compulsory working provision into the British patent laws, but there is, as we look at it, altogether too much disposition to look upon Great Britain as the chief sinner in this matter, the fact being that the British provision was primarily a retaliatory measure aimed more especially at the similar provision which has long been in force in Germany. Looked at in a large way, this provision, when considered as a universal practice by all countries, becomes, if not unworkable, at least such a source of international irritation as to be especially objectionable, and this fundamental fact has been forced to the attention of everybody by the action of the British government, and if in this way that action should ultimately lead to the general abrogation of compulsory working clauses, either through special treaties like the one now in progress between Germany and this country, or better yet, through the formal repeal of these clauses in the various countries where they are now in force, it will in the end prove a blessing in disguise.

Insofar as the situation is affected by the new British act, special interest attaches to the fact that action has recently been taken by the Controller, as the result of which two British patents have been annulled because of failure to comply with the compulsory working clause. So far as can be judged from the information at hand, the decision in these cases indicates that the clause will be construed in an extremely drastic manner. Practically every point raised by the patentees was decided against them, even the reasonable interval before actual annulment, which is provided for in the act, being denied, and the patents being revoked forthwith, the aim being, apparently, to avoid establishing a precedent, the effect of which might be to encourage patentees to defer compliance with the requirements of the clause until applications were made to revoke their patents.

Those of our readers who followed our editorials which appeared after the hearings of the House committee on patents last winter will recall that while we expressed entire sympathy with the idea of a retaliatory-compulsory working clause in our own patent laws, we nevertheless expressed grave doubts of the possibility of framing such a clause that would not do more harm than good, and in view of the present situation we must own to feeling well satisfied with it. We believe that the clause in the British act will be found to be a very undesirable measure purely from the domestic standpoint, although it will very likely require some time to demonstrate the undesirable results which we believe, will follow it. A little patience is, however, all that is needed to meet this condition, and we trust that the ultimate result will be the repeal of the objectionable clause by all of the countries that have enacted it into law.

Meanwhile a bill has already been introduced into the House of Representatives providing that patents to citizens of any foreign country shall be framed in the same terms as those issued by the country in question to citizens of the United States. A similar measure was discussed at last winter's hearings, the result being to point out that while the provision is an ideal one in its basic idea it would so complicate the work of the Patent Office and of the courts as to make it practically unworkable. New hearings will be held by the House committee on patents, beginning probably late in the present month.

The Conservation of Natural Resources

An important document relative to the impending exhaustion and the importance of conservation of our natural resources is found in the recent report of the minerals section of the national conservation commission, which contains facts that are startling in their magnitude and importance.

Among the positively criminal wastes that are now going on, the report points out that of natural gas, of which it is stated that one half of the amount now coming out of the earth, about 1,000,000,000 cubic feet per day, or more than

enough to light all the cities of the United States having more than 100,000 population, is wasted by being allowed to escape into the atmosphere—a waste that can be prevented by adequate legislation similar to that now in force in Indiana and one or two other States.

Another resource of which the waste is appalling, although more has been said about it, is coal, of which it is stated that about one-half of the total product mined, or for the year 1907 about 240,000,000 tons, is wasted. The total value of mineral products going to waste is estimated to approximate one million dollars per day in value. The report states that only data considered to be reliable have been used, those of questionable value having been ignored.

Of all our mineral resources the extent of the coal deposits is probably best known, the boundaries of the coalfields being so well known that the discovery of additional deposits of importance is extremely doubtful, and at the present increase in rate of consumption it is estimated that the supplies of high-grade available coal will be exhausted near the middle of the next century.

The data concerning iron-ore supplies are less complete than those concerning coal, but they are nevertheless sufficiently definite to justify estimates placed upon them, and these estimates are that the high-grade iron ores will have been largely consumed by the middle of the present century. As regards iron ores there are enormous quantities of low-grade ores distributed through the iron districts, but these are not available for use under present economic conditions.

The report refers also to the unjustifiable use of oil for power purposes, more than 18,000,000 barrels of petroleum having been used during the past year for locomotive fuel.

The report also points out that for the effective conservation of these resources, the country must depend largely upon State legislation, the Federal Government being limited to investigations of these resources with a view to describing their quality and quantity, and showing how they may be mined and used and their efficiency increased; but the enactment and enforcement of laws looking to the protection of life and the prevention of waste must come chiefly from State legislation.

New Publications

NOTES FOR MECHANICAL DRAWING. By Frank E. Mathewson. 86 8x6-inch pages, with numerous plates and illustrations. The Taylor Holden Company, Springfield, Mass. Price, $1.25.

This is not a textbook, but a large collection of notes, exercises and practical problems so arranged that they can be adapted to any course in mechanical drawing in connection with Y. M. C. A. classes, manual training schools, technical high schools and the like. There are 55 exercises in mechanical drawing, five pages of notes on working drawings, four pages of notes on projections, 18 problems in projections, six pages of screw threads, bolts, nuts, and the like, nine pages of problems in machine design from proportions given in the text, four pages of problems in isometric drawing, nine pages of problems in mechanical motions and 13 pages on gearing. The material is well selected, well graduated, and should serve its purpose well as a basis for a general course in mechanical drawing. A few changes might be wished for in order to bring the work more nearly in accord with present day drawing-room practice, as but a limited use is made of drawing-room conventions. These are fairly well standardized for the principal drawing rooms of this country, and there seems to be no good reason why such conventions should not be taught in every course of mechanical drawing. In the section devoted to screw threads we find no mention of multiple threads, and in view of that fact the definition given of the lead of a screw as "the distance its nut would travel along the axis in one turn of the screw" seems a little awkward, although it is correct. Turning to the section on gearing, the fundamental formulas are unduly abbreviated, and there are several forms of gear teeth that are in greater use and of more value today than the cycloidal system, which is treated in detail. Such systems as the stubbed-tooth spur and parallel-depth bevel are not mentioned at all. These points, however, are minor, and should not be considered as seriously detracting from this valuable series of notes on mechanical drawing.

ACCURATE TOOL WORK. By C. L. Goodrich and F. A. Stanley. 217 6x9-inch pages, with 221 illustrations. The Hill Publishing Company, New York. Price $2.

Those of our readers who have followed the articles which we have published during the past year on high-class toolmaking methods, from which this volume is largely made up, will understand its scope, although we believe that in their collected form with the proper grouping of topics, which, in a periodical, are necessarily discussed in a somewhat disconnected manner, there will be a large element of surprise at the thoroughness with which the work of the toolmaker has been covered. The manner in which the articles were received by our readers, combined with the belief that they have permanent value, has led to their publication in book form.

The best method of showing the scope of the book is to give a list of its chapter headings, which are as follows:

Locating and boring holes in drill jigs; locating and boring oblique holes in jigs; economical jig work on the milling machine; boring holes on the miller and checking with verniers; a precision drilling and reaming machine; master plates, and how they are made; master plates and their uses in die making; master plates used in making watch tools; trigonometry in the tool room; a tool for laying out angles; measuring dovetail slides, gibs and V's; a gage for producing accurate shapers; the microscope in the tool room; the microscope in the manufacturing plant; making a set of accurate index dials; inspecting tools with the test indicator; a universal indicator and some of its applications; a new Swedish combination gaging system; setting, laying out and testing work with the Swedish gages.

It is not too much to say that discussions of most of these topics are not to be found in any other existing book, this one being, therefore, in a class by itself. It is a remarkable fact that work of this character, which is the stock in trade of every high-class toolmaker, should have been practically unprinted until we set about gathering it a year or more ago, and we cannot imagine a toolmaker, or would-be toolmaker, who will not find both pleasure and profit in the numerous illustrations and the clear, shoppy descriptions of tool-room work, nor, we believe, are there many toolmakers to whom much of the information is not new and of exactly the character which they want. The book deserves a place in the tool chest of every toolmaker, and we do not doubt that it will find its way to most of them.

Personals *

Morris A. Hall, formerly superintendent of the Mack Brothers Motor Car Company, and a contributor to our columns, has recently joined the staff of the *Automobile*.

William Wadleigh, for the past three years general superintendent of the Coffin Valve Company, has severed his connection with that concern to accept the position of chief inspector for the Charles River Basin Commission, Boston, Mass.

James B. Davidson, who has been with the Colburn Machine Tool Company for the past six years, in the capacity of assistant superintendent, has resigned, and since the first of the year has been acting as superintendent of the Vanango Manufacturing Company, Franklin, Penn.

Charles H. Besly

Charles H. Besly, president and founder of the firm of Charles H. Besly & Co., Chicago, Ill., died on December 31 in his own city, of an illness of short duration.

As Mr. Besly was a well known figure in the machinery world, a more extended notice of his life's work will appear in a later issue.

*Items for this column are solicited.

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make it Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

The Townsend Riveter

The riveting of this machine is accomplished by a large number of blows which are so light as not to distort the work or affect it in any way except at the riveting itself. The general appearance of the machine is shown in Fig. 1 (which can also be supplied as a bench machine), while Fig. 2 shows the construction of the hammer head with its multiplicity of hammers, in the shape of rollers, loosely mounted in the revolving cage. This gives as many blows per revolution as there are rollers, and in practice this runs from 4800 to 18,000 per minute, according to the size of rivet.

As the hammers revolve, they strike the plunger which acts on the riveting die, the work being raised into contact with the hammer by the treadle beneath. The rapidity of the blows allows the riveting to be done nearly as fast as the operator can put the work into the machine. This also gives a highly polished rivet head.

On work heavy enough to act as its own stop without being damaged by the riveter, rivets of various lengths may be handled without changing the adjustment of the sleeve holding the die. All adjustments are very simple, and a stop is provided for limiting the movement of the work. It is made by the H. P. Townsend Manufacturing Company, 32 Union Place, Hartford, Conn.

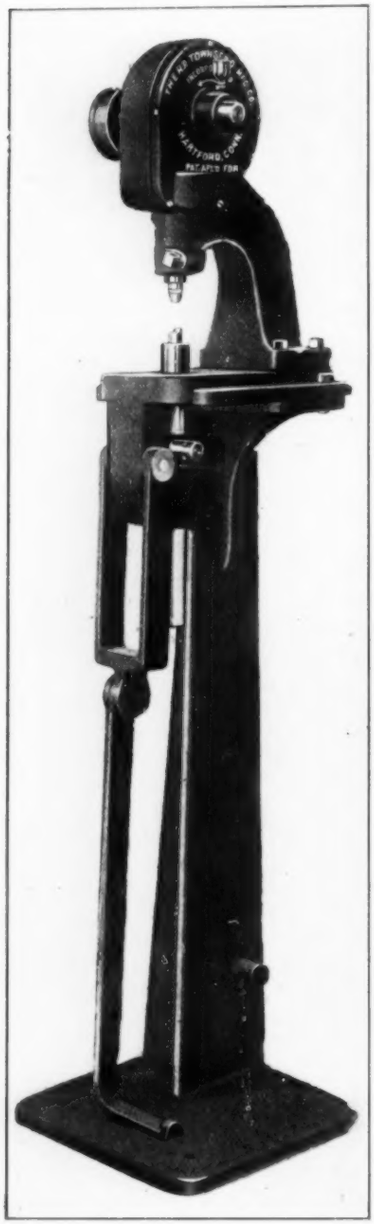


FIG. 1. THE TOWNSEND RIVETER

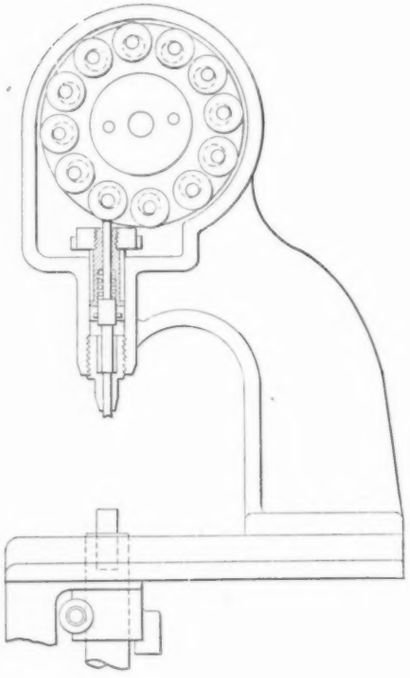
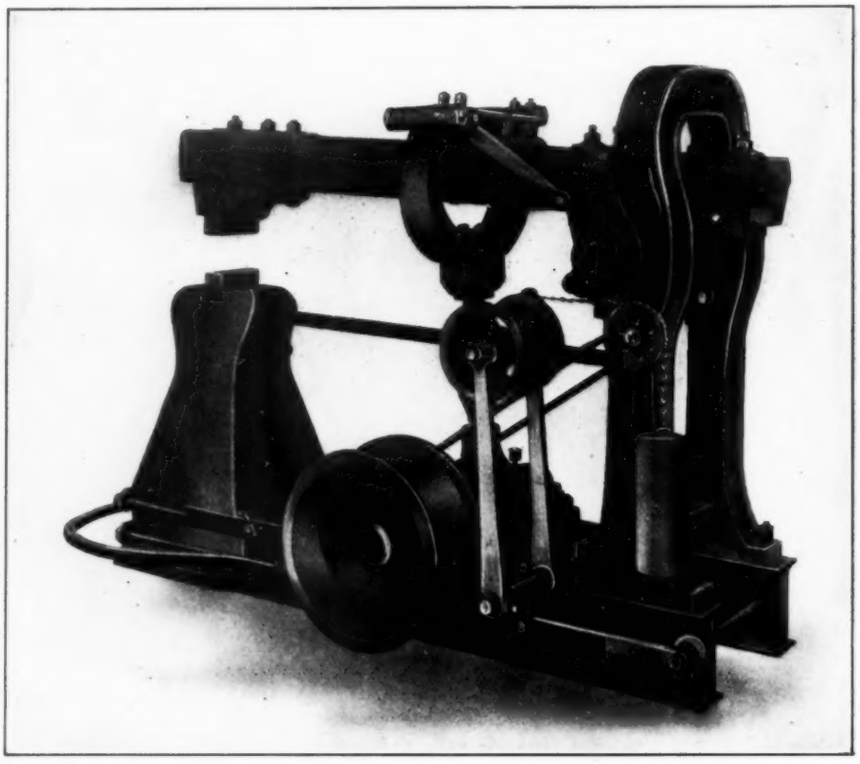


FIG. 2. CONSTRUCTION OF HAMMER HEAD

The Rochester Helve Hammer

The small forge shop handling metal up to 2x2 inches or the larger one, up to 4½x4½ inches are both covered by these



THE ROCHESTER HELVE HAMMER

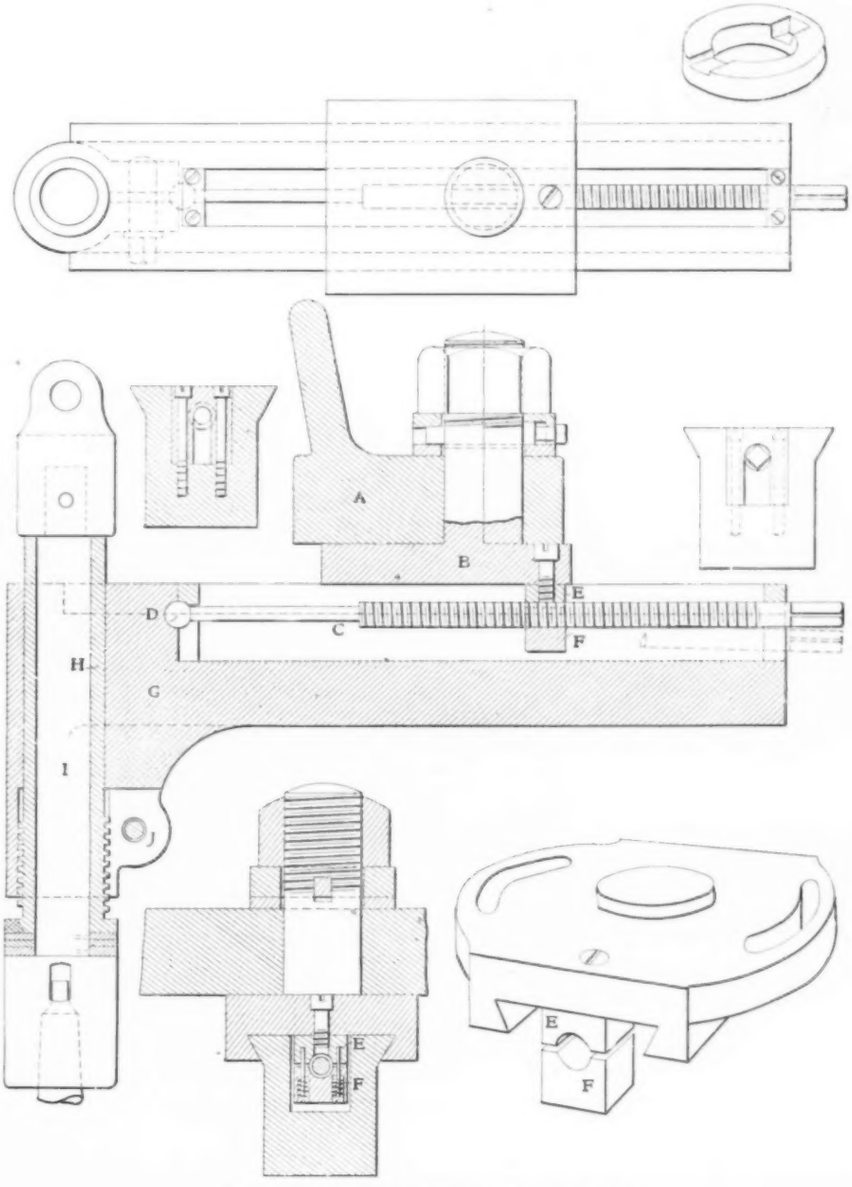
machines. The smaller one strikes 400 blows a minute while the larger one has a capacity of 250, and they all can vary the blows from the figures given, down to zero. This is done by controlling the idler, and with it the slip of the belt, by the treadle around the hammer.

The stroke of the helve is given by an eccentric and rod connecting to the U-shaped leaf spring attached to the hickory helve. This gives a cushioned stroke and is adjustable by the handle at the side, to give a longer or shorter stroke, this being accomplished by moving the spring along the helve. These hammers are made by the West Tire Setter Company, Rochester, New York.

Rapid Adjustment for Multiple Drills

The rapid and accurate setting of the various spindles of a multiple drill is a very desirable feature on any machine of this type, and the device shown herewith has been designed to aid in this class of work.

In the illustrations shown, *A* is the frame to which the spindles are attached, and *B* the attaching plate or bracket which swivels in frame *A*. To *B* is fastened a spring nut, the upper half *E* being threaded and the lower half, *F*, plain, being held together by a pair of springs, as shown in the end view below. The screw *C* is hinged by the ball end *D*, and can be thrown out of mesh by forcing down the outer end, separating the nut and taking the threads out of contact. This allows the whole arm *G* to be slid in either direction for rapid adjustment to the desired point, the screw brought up into mesh with the nut and the final adjustment secured by the screw. Where necessary on account of crowded space, the screw can be turned by bevel gears at the side.



RAPID ADJUSTMENTS FOR MULTIPLE DRILLS

The plate *B* swivels in *A* for any side adjustment and, to avoid twisting it with a final adjustment of the nut the washer beneath carries a taper key which goes through the bolt and draws it up to place with the small set screw shown. This arrangement allows the spindle to swing into any position, but where this is not necessary the swivel plate shown below, carrying the split nut instead of *B*, can be used.

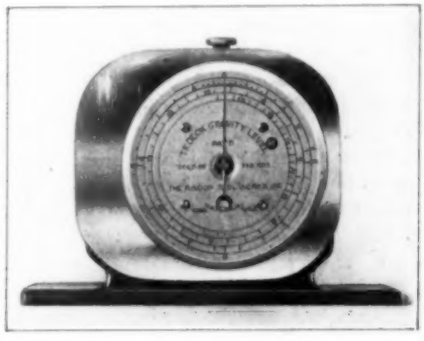
The outer end of *G* carries the bushing *H* threaded at its lower end, and forming a long bearing for the drill spindle *T*. This allows all necessary vertical adjustment of the drill spindles, independent of each other and affords a rigid support at any point of adjustment. The threaded end of the bushing can be locked by the bolt *J*, drawing together the split end of *G*.

The combination of these various devices makes an arm or unit for multiple drilling machines which can be easily and quickly adjusted, thus saving time in setting up the machine. It is the invention of Frank E. Bocorcelski, superintendent, Baush Machine Tool Company, Springfield, Mass.

Gravity Level for Machinists

In this instrument the usual vial or tube with its liquid and bubble has given way to an accurately made gravity movement. It has a 6-inch base, accurately scraped to a straight surface, and is intended for accurate work.

The dial is graduated to read from



A SENSITIVE GRAVITY LEVEL

level up to 18 inches to the foot out of level and also has zero marks indicating level with the instrument upside down, or on either side of a vertical surface. The thumb screw is actuated by a brake to check oversensitiveness, but does not lock it in any position, thus avoiding any chance of cramping or injuring the parts by its injudicious application.

The instrument is extremely sensitive, as can be tested by trying to hold the hand at zero, which should not be even attempted on the morning after, a very slight variation being easily detected. It is made by the Risdon Tool Works, Inc., Waterbury, Conn.

The Coffman Horizontal Boring Machine

Perhaps the most striking feature of this machine is the use of the over-arm for supporting the boring bar in cases where it must extend a considerable distance before entering the work, or where one or more milling cutters are used.

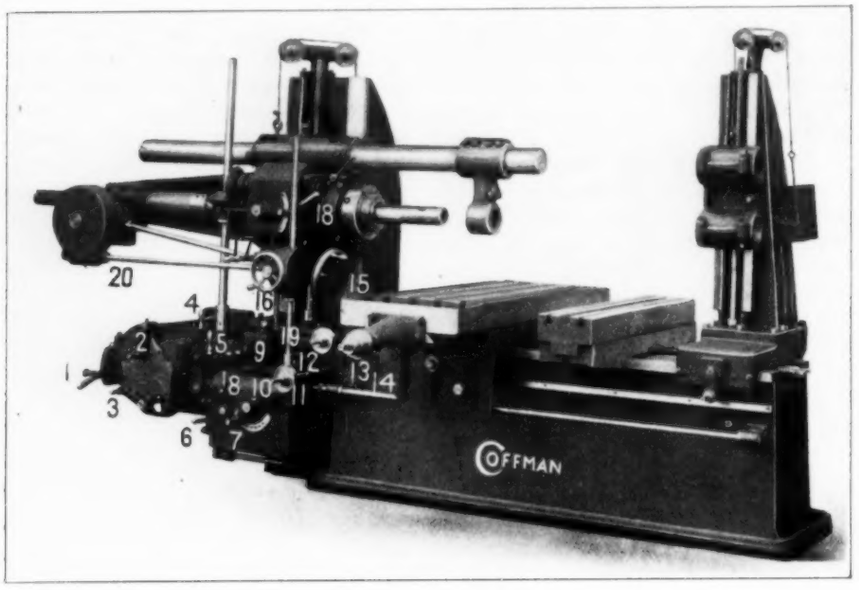


FIG. 1. THE COFFMAN HORIZONTAL BORING MACHINE

The whole driving mechanism is of interest, however, the object being to arrange the various handles so as to be convenient for the operator.

The constant-speed pulley is at the back, driving shaft *A*, as in Fig. 2, which carries a cone of pulleys. The tumbler gear on shaft *B* meshes into any of these, according to its horizontal position which is controlled by a section operated by handle 2. The tumbler transmits power to *C* and from this to *D* and *E*. From here it goes to the vertical shaft *F* and drives the boring bar or spindle through the gear in the saddle, as seen in Fig. 1.

The main clutches are controlled by lever 3, which acts through the cams shown in Fig. 3. The handle is fast to shaft *Z*, and as this is moved to the right, the right-hand cam throws in the clutch *V*, while the others remain disengaged. Moving the handle back, disengages clutch *V* and leaves all open, as shown, while moving one notch to the left throws in clutch *X*, and moving still further disengages this and throws in clutch *W*, clutch *Y* remaining idle during both these movements. In this way the one cam controls all three clutches and prevents two being engaged at once.

Returning again to Fig. 1, lever 5 controls the elevating gear which is connected directly to the main drive and is always constant regardless of the speed of the boring bar. Hand adjustment for final setting is controlled by shaft 11, which is not connected to the vertical shaft, as it appears to be. Both the boring head and outer bearing move together, either by hand or power.

The boring bar in this No. 8 machine is fitted with a No. 6 Morse taper 3¼ inches in diameter, and has a travel of 30 inches at each setting, with a total travel of 60 inches. Its movement can be stopped and started right at the head by lever 18, the central positions leaving the bar stationary and the others giving two different speeds, one for boring and the other for facing. The reverse is controlled by lever 4.

The bar is driven by a feather through a long sleeve, the sleeve running in boxes made by pouring babbitt over a brass netting set with blocks of graphite, as shown in Fig. 4. The box is first bored, cut with dovetail grooves and drilled in each end, then the babbitt rolled before boring. The spots of graphite assist lubrication and tests more severe than would be met in practice, indicate that it successfully prevents heating. The front bearing of the bar is taper, as can be seen in the details of Fig. 5, and the square head which appears in the spindle collar in Fig. 1, controls the bevel pinion,

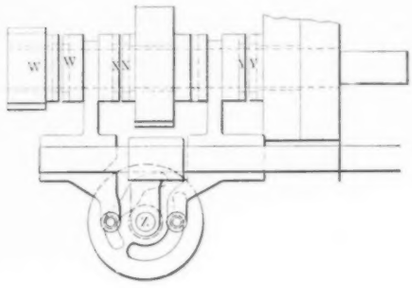


FIG. 3. THE MAIN CLUTCH

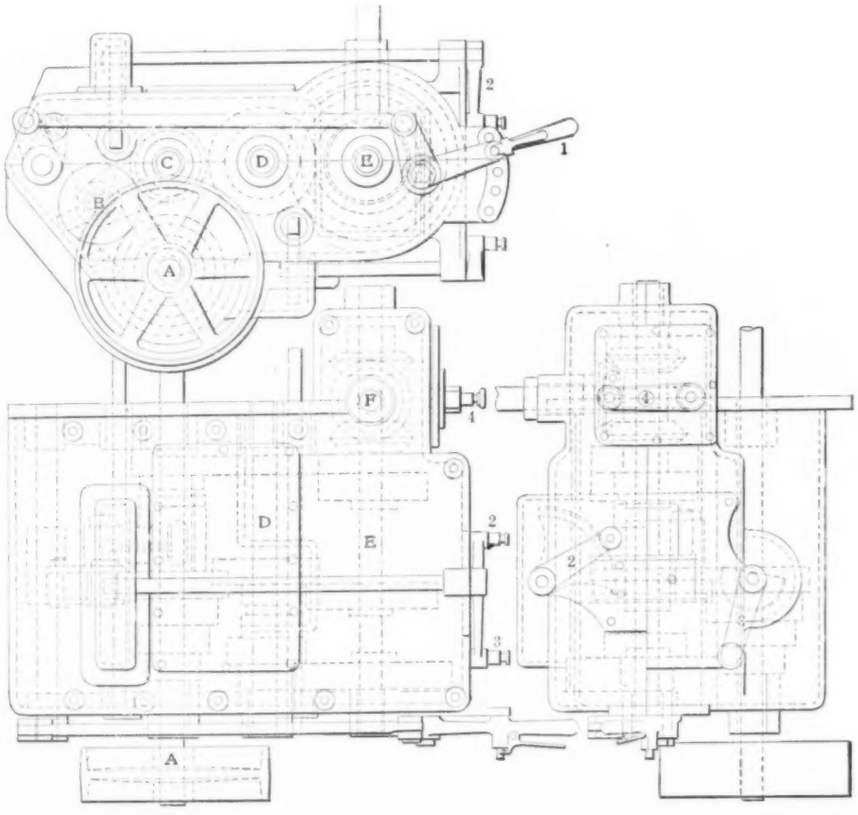


FIG. 2. DRIVE GEAR BOX

shown in Fig. 5, turning the bevel ring *M* and closing the cone position *N* the same as a collet chuck.

The bar feed is by a rack cut on the under side of the rear sleeve, the power feed coming up through shaft 19 and driving worm 20. Hand feed is through wheel 16 with power thrown out by lever 10, while throwing out clutch 17 enables a quick movement of the bar by hand wheel 15.

All feeds come from the same feed box, 13 being the cross feed and 14 the feed lever for table. The feeds are reversed by lever 8, while 6 controls the tumbler gear the same as 1 in the main drive, both being built on the same plan.

The table has a working surface of 24x48 inches and a total length of 64 inches with a travel of 48 inches, and a circular table can be furnished if desired.

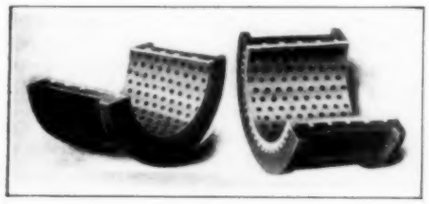


FIG. 4. THE SPINDLE BEARINGS WITH GRAPHITE INSERTS

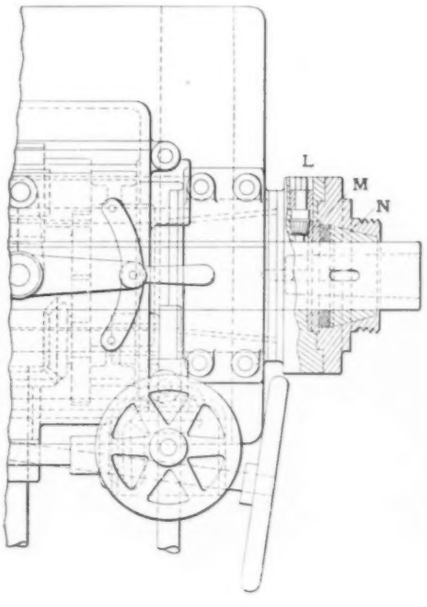


FIG. 5. CENTER BORING-BAR BEARING

Horizontal Boring, Drilling and Milling Machine

The engravings, Figs. 1 and 2, illustrate front and rear views of a horizontal boring, drilling and milling machine arranged with a single pulley drive.

The spindle of this machine is 5 inches in diameter, 94 inches long over all, and has an automatic feed and hand adjustment of 42 inches. The spindle is driven by a sleeve which revolves in brass bushed bearings 16½ inches long on each side of the driving worm wheel. Motion is transmitted from the 4½-inch face driving pulley through the speed box (integral with the head) to the driving worm which is of hardened steel and the thrust on both ends of which is taken by Standard Roller Bearing Company's thrust bearings. The speed box contains nine steel gears, three mounted on each sleeve; two of these sleeves have cross adjustment on their driving shafts in order to bring the different combinations into mesh. This cross adjustment is obtained by segmental gears mounted on the bottom of the two latch levers shown in the front view, engaging a rack shaft on which are mounted yoke clutch levers inside of the head. An idler clutch gear, mounted on the pulley shaft, engages with the gear shown near the face of the machine in Fig. 2, and gives the power elevation to the table when the clutch is connected by the lever *A*, Fig. 1. Hand elevation is obtained by the squared shaft *B*. The elevating screws are made right and left hand as are also the worm and worm wheel operating them. This keeps the pressure in opposite directions and prevents the nuts from jarring loose when taking heavy cuts. The feeds and fast traverse to the spindle are taken directly from the end of the driving worm shaft through the gear box shown clearly in Fig. 1, in which are mounted nine gears giving nine changes, also three gears giving fast traverse with connections to the wheel shown, by which the hand adjustment is controlled. Lever *C* is for the main clutch in the transmission of this feed and fast traverse motion. Lever *D* operates the pull pins and lever *E* engages the fast traverse and feed clutch. There are available spindle speeds of from 7 1/3 to 758/10 revolutions per minute and feeds

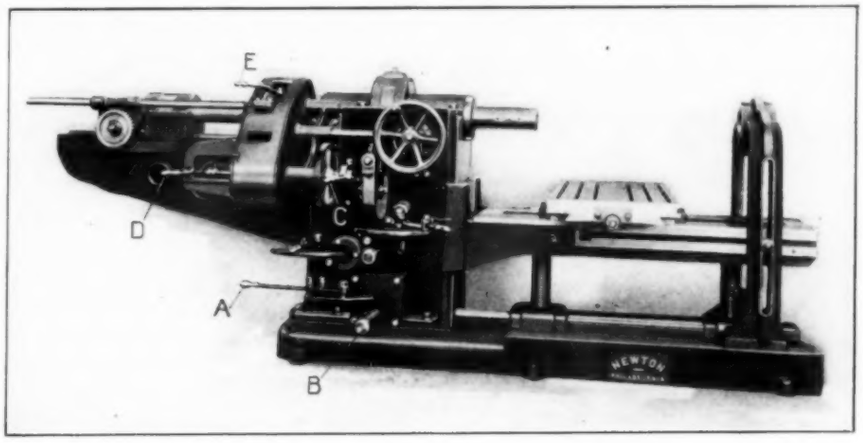


FIG. 1. HORIZONTAL BORING MACHINE WITH SINGLE DRIVING PULLEY

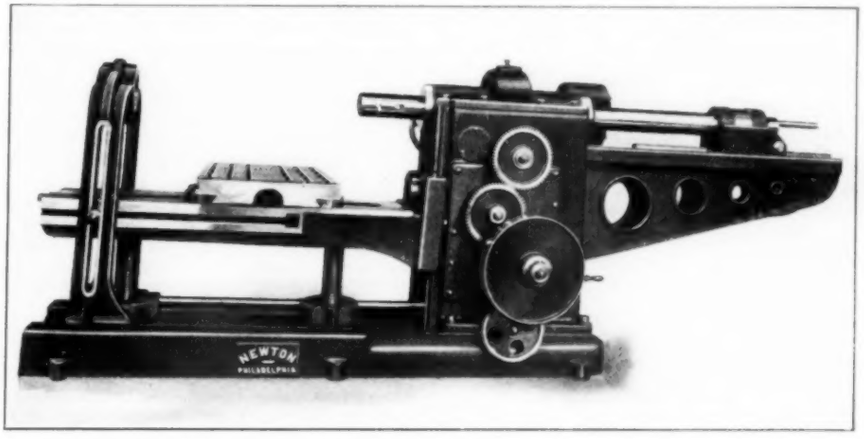


FIG. 2. REAR VIEW HORIZONTAL BORING MACHINE

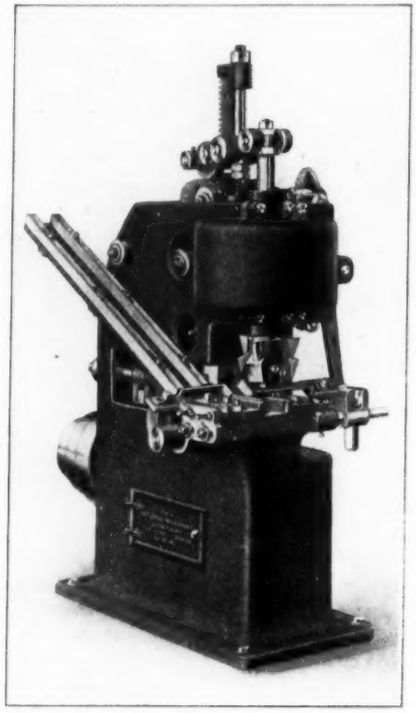
The boring-bar saddle has a vertical feed of 33 inches and the bar speeds are from 10 to 212 revolutions per minute, with 24 changes in all. There are 21 feed changes from 0.004 to 0.5 inch per turn of the spindle. The machine is made by J. P. Coffman, Franklin, Penn.

of from 0.005 to 0.115 per revolution of spindle. The work table to 25 inches wide, 60 inches long and has hand cross adjustment. The knee is 6 feet in length. The maximum distance from center of spindle to top of work table is 26½ inches and the minimum distance 1 inch.

This machine is built by the Newton Machine Tool Works, Philadelphia, Penn.

A Nut Burring Machine

The half-tone shows a machine for removing the burs or fins from hot-pressed nuts. The nuts to be burred are placed



A NUT BURRING MACHINE

in the inclined trough to the left of the machine. They are taken automatically from the bottom of the trough and passed under the cutting head which removes the fins. The cutting head adjusts itself automatically for different thicknesses of nuts and trips on blank nuts. Safety reliefs are provided at all points necessary. The machine shown handles square and hex. hot-pressed nuts from ⅝ to 1¼ inches. It is made by the National Machinery Company, Tiffin, Ohio.

Design of a Short Run Plunger Elevator—Errata

The equations near the bottom of the first column of page 954 of our last year's volume should read as follows:

$$p \cdot x = (x + d) \cdot o$$
$$p \cdot x = x \cdot o + d \cdot o$$
$$p \cdot x - x \cdot o = d \cdot o.$$

A Large Locomotive Plant

The American Locomotive Company has purchased a plot of 130 acres of land at Gary, Ind., and plans are being drawn for a new plant which officers of the locomotive company say will be the most complete and best equipped locomotive works in the world. The land purchased is twice the extent of that occupied by the largest of its present plants, and when fully occupied will give employment to from 12,000 to 15,000 workmen. The land adjoins that of the new plant of the United States Steel Corporation. This site was selected at Gary, 24 miles from Chicago, to provide for the territory where the largest number of railroads converge to a single commercial center. The company now operates plants in Schenectady and Dunkirk, N. Y.; Pittsburg and Scranton, Penn.; Richmond, Va.; Paterson, N. J.; Manchester, N. H.; and Montreal, Canada. At present there is no large locomotive plant west of Pittsburg, and the selection of a location in the Chicago district provides additional locomotive-building capacity where it most needed for prompt and direct delivery to a large number of railroads. The size of the new plant will be sufficient to provide liberally for the growing needs of the railroads for years to come.

Business Items

Manning, Maxwell & Moore has moved its Boston store to Franklin and Oliver streets.

The pneumatic hammers used in Frederick Thompson's production, "Via Wireless," running at the Liberty theater, N. Y., were furnished by the Independent Pneumatic Tool Company, Chicago, Ill.

The Northern Electrical Manufacturing Company, Madison, Wis., announces the enlargement and removal of its St. Paul district office to 1046 Security bank building, Minneapolis, Minn., T. E. Drohan in charge.

Gisholt Machine Company, Madison, Wis., has opened its new Chicago display rooms at Washington boulevard and Desplaines street, where a line of Gisholt tools has been installed for demonstration purposes.

On and after February 1 Gould & Eberhardt will be represented in the Philadelphia and surrounding territory by the W. E. Shipley Machinery Company, The Bourse, Philadelphia, instead of the Fairbanks Company, of Philadelphia, as formerly.

Stanley G. Flagg & Co., manufacturers of pipe fittings, malleable and small steel castings, has discontinued its representation in New York on a commission basis, and has taken over the office previously used by it and is operating it as a part of its own sales department, R. G. Williams in charge.

The American Steam Gauge and Valve Manufacturing Company, Boston, announces that after January 1, 1909, John B. Guthrie will be its sole representative in the Pittsburg district, with offices in the Columbia bank building, corner of Fourth avenue and Wood street, Pittsburg, Penn.

The American School of Correspondence, Chicago, announces the opening of a new branch of correspondence study, "Short Courses for Busy Men." These include courses in machine design, tool making, pattern making, foundry and forge practice, machine shop work, alternating current machinery, etc.

Douglas Gordon, who has been connected with an American engineering company as manager for a number of years, is making arrangements to establish himself in London next April and desires to get in touch with American machine and supply manufacturers with a view to selling their products in the British Isles. Mr. Gordon's present address is 165 Naples Road, Brookline, Mass.

Trade Catalogs

B. C. Ames & Co., Waltham, Mass. Catalog of dial gages. Illustrated, 12 pages, 8x9½ inches, paper.

West Tire Setter Company, Rochester, N. Y. Booklet describing Rochester helve hammer. Illustrated, 3½x6 inches.

General Electric Company, Schenectady, N. Y. Bulletin No. 4628, describing mercury arc rectifiers. Illustrated, 12 pages, 8x10½ inches.

Wagner Electric Manufacturing Company, St. Louis, Mo. Bulletin No. 82, describing polyphase motors. Illustrated, 16 pages, 8x10½ inches.

Western Electric Company, 463 West street, New York. Booklet No. 1078. Magneto telephone wall sets. Illustrated, 16 pages, 3½x6 inches.

Wiley & Russell Manufacturing Company, Greenfield, Mass. Catalog No. 34, illustrating and describing full line of screw cutting tools, machine relieved taps, reamers, bolt cutters, etc.

Business Opportunities

The Sumner Iron Works, Everett, Wash., will enlarge its machine shop.

The plant of the Loudonville (Ohio) Handle Company was destroyed by fire.

Plans have been prepared for a new foundry for the McCord Company, Detroit, Mich.

The Lestershire (N. Y.) Lumber and Box Company is building an addition to plant.

A new factory will be erected for the American Electrical Heater Company, Detroit, Mich.

The P. A. Sorg Paper Company, Middletown, Ohio, will build a $100,000 addition to plant.

The Standard Knitting Company, Cleveland, Ohio, is having a large new factory erected.

The Indiana Bottle and Glass Company, Cicero, Ind., will rebuild plant recently burned.

Mitchell & Van Meter, Pottstown, Penn., are having plans prepared for a brass foundry.

The Milwaukee (Wis.) Woven Wire Works will rebuild plant destroyed by fire some time ago.

The E. B. Norman Lumber Company, Louisville, Ky., will install machinery for making boxes.

It is reported that the Maysville (Ky.) Foundry and Engineering Company will enlarge plant.

The Hedden Iron Construction Company, Newark, N. J., is building a new two-story factory.

Fire in the carriage factory of Hancock & Reidy, Malden, Mass., caused a damage of $50,000.

The Turner & Seymour Manufacturing Co. Torrington, Conn., will build an addition to foundry.

The Auto-Car Equipment Company, Buffalo, N. Y., has had plans prepared for a new factory building.

The New Process Steel Company, Marshall, Mich., is building two additions to plant, one being a foundry.

The Lincoln Furniture Company, Philadelphia, Penn., has commenced erection of its new $200,000 factory.

The Hoopeston (Ill.) Horse Nail Company, whose plant was recently burned, will rebuild on a larger scale.

The Turner, Day & Woolworth Handle Company, Bowling Green, Ky., will install additional machinery in plant.

Oman & Johnson Co., Willmar, Minn., will erect a foundry to be operated in connection with machine shop.

The Raymond Manufacturing Company, Middletown, Penn., making stoves, will reorganize and enlarge foundry.

A three-story addition will be built at the plant of the Wisconsin Knitting Mills Company, Manitowoc, Wis.

Ground has been broken for a factory for the M. M. Converse Rubber Company, Malden, Mass., recently organized.

The plant of the Fox River Valley Knitting Company, Menasha, Wis., was destroyed by fire. Loss, about $70,000.

The saw-mill plant of the Matthews Lumber Company, at Wham, La., was destroyed by fire, causing a loss of $50,000.

Beeker, Smith & Page, Philadelphia, Penn., manufacturers of wall paper, will erect a new plant to cost about $200,000.

The plant of the Electric Heating and Manufacturing Company, Alhambra, Cal., was burned, causing a loss of over $30,000.

Contract has been awarded by the Wood Turret Machine Company, Terre Haute, Ind., for the construction of plant.

The Wilkinson-Knupp Brass Company, Greenville, Penn., will erect a plant for the manufacture of valves, fittings, pumps, etc.

The Oklahoma School Desk Company, Cherokee, Okla., will establish foundry and machine shop to manufacture iron castings for desks.

It is reported that the North Coast Railroad contemplates erecting shops at Spokane, Wash. R. E. Strahorn, Spokane, is president.

The Cain & Galle Co., Chicago, Ill., proposes establishing a plant in La Fayette, Ind., for manufacturing galvanized iron delivery baskets.

The shops of the Great Northern Railroad Company at Hillyard, Wash., are to be enlarged. It is said improvements will cost over $200,000.

The Sanitary Can Company has begun the erection of another large addition at its plant in Freeport, N. Y. This is to be used as a box factory.

The Carolina, Clinchfield & Ohio Railway will build shops at Erwin, Tenn. M. J. Caples, Johnson City, Tenn., is general manager.

Plans for the new factory for the Bendix Automobile Company, Logansport, Ind., have been completed and construction will soon commence.

The plant of the Standard Galvanizing Company, at West Pittsburg, Penn., which was partially destroyed by fire will be reconstructed.

The Gibbs Gas Engine Company, Atlanta, Ga., has been organized with $100,000 capital to manufacture a gas engine invented by Geo. W. Gibbs, Jr.

The Columbia (Miss.) Machine and Furnace Company has awarded contract for erection of new plant to replace the one recently destroyed by fire.

The Killian Manufacturing Company, Philadelphia, Penn., operating the Quaker City Ribbon Mills, is completing plans for the erection of a new mill.

The Tennille (Ga.) Manufacturing Company has been incorporated to manufacture lumber, lathes, grille work, etc. Joseph Jackson, president.

The Drew-Haynes Machine Company, Fitchburg, Mass., building special machinery and gas engines, has applied for permit for a new factory building.

It is said the Pope Tin Plate Company will build an open hearth plant at the works in Steubenville, Ohio, for the purpose of manufacturing sheet bars.

It is reported that the McVoy Sheet Metal and Tin Plate Company, Chicago, Ill., has had plans prepared for a new warehouse and manufacturing building.

A large new foundry building, costing about $170,000, will be erected at the Puget Sound navy yard and the foundries of all the departments consolidated.

The Sioux City (Iowa) Foundry and Manufacturing Company is erecting new machine and boiler shop, warehouse, etc. New equipment will be needed.

The Broughton Buggy Company, Elizabeth City, N. C., has been organized for the purpose of establishing a buggy manufacturing plant. W. T. Old, president.

The Tennessee Can Company, Chattanooga, Tenn., is being organized to manufacture tin fruit cans. F. B. Schultz, of Chattanooga, is secretary and treasury.

The Superior Iron and Steel Company, Warren, Ohio, has been incorporated with $300,000 capital and will operate plant. C. T. Clapp, of Warren, is president.

The Okmulgee (Okla.) Implement and Manufacturing Company, recently incorporated, will establish plant to manufacture windmills, barrows, pulverizers, etc.

The Aldridge Roller Bearing Manufacturing Company, Plattsburg, N. Y., has been organized with $200,000 capital to manufacture bearing axles for vehicles.

It is reported that the Hines Manufacturing Company, of Portland, Ind., makers of oil-well equipments, will establish branch plants in Oklahoma and West Virginia.

The St. Louis & San Francisco Railroad Company will resume construction of shops at Springfield, Mo., suspended about a year ago. Over $1,000,000 is to be expended.

The Cleveland, Cincinnati, Chicago & St. Louis Railway Company will enlarge the shops at Bellefontaine, Ohio. It is said $10,000 will be spent in enlarging the roundhouse.

The Automatic Rolling Bearing Company, Chicago, Ill., has secured site in Goshen, Ind., on which a new plant will be erected. It is said over 2000 men will be employed.

The Caroline, Clinchfield & Ohio Railroad Company has authorized the expenditure of $200,000 for the construction and equipment of its new shops at Johnson City, Tenn.

The Plant City (Fla.) Foundry and Machine Company, organized with $10,000 capital, will establish plant to manufacture boilers, repair locomotives, etc. C. A. Root, president.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m. January 25, for steel, iron, castings, chain, wire rope, exhaust heads, etc., as per Circular No. 487.

The nail-cutting plant of the Williamsport (Penn.) Iron and Nail Works, which was burned a short time ago, will be rebuilt at once. Improved machinery will be installed.

The Texas & New Orleans Railroad has secured land at Huntington, Texas, on which roundhouse, blacksmith and repair shop, power house, etc., will be erected. W. G. Van Vleck, Houston, manager.

The Spokane (Wash.) Paper and Pulp Company is being organized by C. B. Pride, president of the Tomahawk Paper and Pulp Company, of Tomahawk, Wis. A $850,000 plant will be erected.

It is reported that the T. H. Symington Company, Baltimore, Md., manufacturing journal boxes, malleable iron castings, etc., may move its plant at Corning, N. Y., to Rochester. About 1200 men are employed.

The Automobile and Motor Boat Company, Steubenville, Ohio, a new concern, is erecting a building which is to be equipped with modern machinery for the manufacture of automobiles, motor boats and gas engines.

The American-Newfoundland Lumber Company has been organized at Grand Rapids, Mich., with $800,000 capital to do a logging and lumbering business in Newfoundland, and also erect a paper and pulp mill. C. F. Sweet and H. G. Dyckhouse, Grand Rapids, and others, organizers.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: January 19—Dynamo (schedule 804), generator set (schedule 800), motors (schedule 803), multipolar motor, switchboard (schedule 800), ball bearings (schedule 802), bolts and nuts, air drills, pneumatic hammers (schedule 804), hand drills (schedule 803), pulleys (schedule 802), nickel steel forgings, steel (schedule 801) steam gages, etc. (schedule 804). February 2—Jack chains, clamps, reamers (schedule 795), motor (schedule 794), tool steel, machinists' taps, carborundum wheels (schedule 795). February 9—Gage testing apparatus, chucks, bench drills, pneumatic drills, grinders, lathes, engraving machine, milling machine, slotting machine, drill press, cutting-off saw, shaper, swivel vises (schedule 797).

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E. G. Smith Co., Columbia, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Draftsmen—Use my parallel device instead of a T-square; $2.50. F. G. Hobart, Beloit, Wis.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Machinery built to order; up-to-date plant. Write Brunswick Refrigerating Co., New Brunswick, N. J.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Machines designed; automatic, special. Practical working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

For rent, in best part of Manhattan, first-class general construction and machine shop, also large storage room. Apply on premises, S. Healey Co., 650 West 51st St., New York.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MACH.

A firm of consulting and contracting engineers desire contracts for designing and drafting. Automatic and special machinery and tank and filter apparatus our specialty. "T. & L.," Box 828, AMERICAN MACHINIST.

A first-class mechanical engineer wants parties to take up the manufacture of gasolene traction engines. Will furnish plans alone, or plans and services to build and dispose of product. Box 811, AMER. MACH.

Wanted—Manufacturer to make and sell a "cut meter;" for determining cutting speeds on metal. Good business opportunity. Full information on application. Address "F. M. C.," No. 37 Lynwood Place, New Haven, Conn.

New patent laws. A firm of high-class machine toolmakers with modern plant (including foundry) are prepared to undertake the manufacture of suitable patented specialties on behalf of foreign patentees who are desirous of complying with the new patent laws. Roberts Bros., Dukinfield, Manchester, England.

Sell your tools in the Far East. The only successful method is to have your own representative in the field. This method opens a field of immense possibilities for you worth investigating. I want to hear, in confidence from, at most, ten manufacturers who will share the costs of such representation. It will be to your advantage. A. Gwajkokuljin, Box 839, AMERICAN MACHINIST.

Manufacturer wishes complete information covering the best and cheapest method of etching on hard steel, such as saws, rules, safety razor blades, etc. Process must produce clear, sharp work, yet be very cheap. In replying, state price wanted for the information and name several articles etched by your process, together with the cost of doing the work. If possible, submit samples, naming cost of etching. Box 827, AMERICAN MACHINIST.

The annual meeting of the stockholders of the Hill Publishing Company, for the election of directors for the ensuing year and for the transaction of such other business as may properly come before the meeting, will be held at the office of the company, in the Hallenbeck building, 497-505 Pearl street, Borough of Manhattan, New York City, N. Y., on Tuesday, January 26, 1909, at 12 o'clock noon.
Dated, New York City, December 19, 1908.
Robert McKean, Secretary.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Expert designer of printing and bookbinding machinery. Shop management, cost system, etc. Box 829, AMERICAN MACHINIST.

Wanted—Position as draftsman by experienced detailer and practical toolmaker. Box 830, AMERICAN MACHINIST.

I wish to correspond with any company desiring the services of a progressive and up-to-date manufacturing superintendent. Box 813, AMERICAN MACHINIST.

DELAWARE

Situation by man of 36 with 20 years' practical experience in medium and small machinery (gasolene engines and small tools). Thorough business experience and capable of designing and estimating. Box 823, AMERICAN MACH.

ILLINOIS

Tool room foreman desires change; first class on tools for adding machines, cash registers and typewriters. Box 764, AM. MACH.

MICHIGAN

Superintendent, up on rapid duplication of parts in manufacture of gas engines and other lines, soon open to change. Strong on jig design. Age 40; best references, all particulars. Box 841, AMERICAN MACHINIST.

Manager, experienced in manufacture and sale of gasolene engines and other machinery, and operation of grey iron foundry seeks opening. Investment if desired after making good. References as to habits, character, ability. Young man, hustler, competent. Box 842, AMERICAN MACHINIST.

NEW JERSEY

Mechanical draftsman wishes position. Box 845, AMERICAN MACHINIST.

Mechanical engineer and draftsman, 15 years' experience, seeks situation with firm wishing to go into motor car building. Advertiser has set of working drawings, and is capable of taking charge of shop and drawing office. Box 822, AMERICAN MACHINIST.

NEW YORK

Experienced designer for jigs, fixtures and machine tools open for engagement. Box 844, AMERICAN MACHINIST.

Mechanical draftsman, expert in pumping machinery, wants a position. Box 840, AMERICAN MACHINIST.

Draftsman—Six years' experience in general and automatic machinery; also three years' practical shop experience. Box 832, AMERICAN MACHINIST.

Mechanical expert, practical and inventive, with 12 years' experience in designing and developing automatic machines, desires change. Box 826, AMERICAN MACHINIST.

Draftsman, mechanical engineering graduate, seven years' experience with large concerns. First-class layout and detailer. "G. M.,", AMERICAN MACHINIST.

Superintendent or manager, practical and executive, in machine shop and foundry. Up-to-date mechanical and business experience. Best references. W. S. Morehouse, Fishkill-on-Hudson, New York.

Responsible position wanted by expert mechanic, technical graduate, designer of turbine pumps, engines and marine boilers. Seven years' experience in America and abroad. At present head of drawing department of leading concern. Box 821, AMERICAN MACHINIST.

Mechanical engineer is open for engagement as superintendent, master mechanic or general foreman; technical education; large experience as designer and manufacturer of interchangeable machinery, sheet metal goods, electric instruments, typewriters, etc. Box 804, AMERICAN MACHINIST.

Gas engine and automobile designer. Technical university graduate. Thorough knowledge and experience of all the practical and theoretical requirements, latest improvements and ideas concerning automobile and gas engine design and manufacturing. Open for engagement. Box 843, AMERICAN MACHINIST.

OHIO

Superintendent, chief engineer and designer, 12 years' practical experience, thoroughly versed in best shop practice; executive ability, and an inventor; prefer small company that wants to improve their line; any locality. Box 810, AMERICAN MACHINIST.

PENNSYLVANIA

Systemizer-Cost Clerk—10 years' experience At present employed. Location, Philadelphia or vicinity. Box 825, AMERICAN MACHINIST.

A young up-to-date mechanic, first class on tools, dies and experimental work; also as inspector or foreman, desires position. Box 835, AMERICAN MACHINIST.

Cost expert, systematizer and chief draftsman; 12 years' experience; will be open for position after March 1; technical graduate. Box 800, AMERICAN MACHINIST.

Works manager or superintendent desires position. Up-to-date and very successful manager of men. Has effected great economies in present position. Box 824, AMER. MACH.

Young man, 28, technical graduate, with six years' shop and drafting room experience, wishes position with manufacturing concern off the board with opportunity for advancement. Opportunity more desired than present salary. Box 820, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

ILLINOIS

Superintendent for screw machine factory. Must be thoroughly competent. Fine opportunity for the right man. Duce Mfg. Co., care Chas. T. Frantz, 505 Commercial National Bank Bldg., Chicago.

MASSACHUSETTS

Wanted—Mechanical draftsman, accustomed to medium size machine tool work. None other than a first-class man capable of taking charge of a few men need apply. Reply, stating age, experience, etc., to P. O. Box 632, Springfield, Mass.

Wanted—Foreman for tool and repair department; good mechanic with experience in making cutters, hobs and forming tools, and doing repair work on general machinery. State age, experience and wages expected. Box 781, AMERICAN MACHINIST.

Wanted—Man in office of gear cutting shop as general assistant to manager; must have good mechanical judgment, and be quick at figures. One experienced in gear business preferred. State age, experience and salary expected. Box 782, AMERICAN MACHINIST.

MICHIGAN

Foreman wanted by machine shop making high-class machinery, employing about 50 men; must be capable and experienced, able to handle men to advantage; state experience, age and wages expected. Address Box 797, AMERICAN MACHINIST.

Wanted—Experienced operator on Potter & Johnston turret machines, who is competent to take charge of several machines, turning out good work advantageously. State experience handling men, wages, age, nationality. We want a man who can turn out a maximum amount of good work. Box 838, AM. M.

NEW JERSEY

Wanted—Draftsman on special machinery; must have shop and drawing room experience. Man with executive ability preferred. State age, experience and give reference and salary. Box 788, AMERICAN MACHINIST.

Salesman—A traveling salesman who is now selling the machine or railroad supply trade, to carry a high grade bearing metal (babbitt) as a side line, on liberal commission basis. Address, with full particulars, Lakewood Metal Co., Box 182, Lakewood, N. J.

NEW YORK

Wanted—Superintendent of manufacturing department in water meter factory. Box 818, care AMERICAN MACHINIST.

Wanted—Designer and draftsman for sheet metal stamping specialties. Address, "Draftsman," Box 831, AMERICAN MACHINIST.

Sales manager wanted by large machine tool building company. None but the highest class man will be considered. Address Box 833, care AMERICAN MACHINIST.

OHIO

Toolmaker; one competent to make tools for rolling and drawing sheet metal. Box 791, AMERICAN MACHINIST.

Wanted—Designer and draftsman experienced on sheet-metal working machinery and automatic feeds for same; state experience and salary expected. Box 815, AM. MACH.

PENNSYLVANIA

Tool room foreman who is up-to-date in all modern methods of getting out new tools, jigs and fixtures at the lowest possible cost. We have steady position for A-1 man of good habits. Box 819, AMERICAN MACHINIST.

WISCONSIN

Shop superintendent wanted in the manufacture of lubricating specialties. Must have ability to get up new designs. State experience and salary expected. Box 762, AMER. MA.

FOREIGN

Wanted—Capable engineer, with technical education and mill experience for good and permanent situation at rolling mill in the middle of Sweden. Apply, stating full particulars of age, education, experience, salary wanted, and inclosing copies of testimonials to "Rolling Mill Engineer," care of S. Gumealii Annonsbyra, Stockholm, Sweden.

Professorship in mechanical engineering. The Norwegian government (church and educational department) desire to appoint a professor in mechanical engineering for the Tekniske Hiskole (Polytechnic Institute), at Trondhjem, Norway. The Polytechnic Institute will probably be opened after the summer of 1910, but the appointment may date from the beginning of 1909, the professor meanwhile assisting in laying out plans for engineering laboratory and such other preparatory arrangements as he may be able to undertake. As it is conceivable that some time may elapse after the remuneration, as above mentioned, with the plans. The professor must be sufficiently acquainted with the Norwegian language. The form of application is "To the King," and should be addressed to "Den norske Regjerings Kirke—og Undervisnings—departement, Kristiania"—before the end of January, 1909.

For Sale

Twenty volumes AMERICAN MACHINIST. Volumes 11 to 31 inclusive. R. M. Clough, Tolland, Conn.

For Sale—Greenfield Universal tool and cutter grinder, at a bargain. As good as new. Box 837, AMERICAN MACHINIST.

For Sale—One-half interest in machine shop, doing nice business, located in Central, Mich. Partner must be able to take charge of shop. Address Box 807, AMER. MACHINIST.

For Sale—36x36x12 planer, 2 heads, 24" shaper, 36" drill press, 1¾" P. & W. automatic, ⅝" P. & W. automatic, 24"x12' lathe; A-1 condition. Box 834, AMER. MACHINIST.

For Sale—Patent on tobacco stemming machine which has been tested. Simple and cheap to manufacture. Would make good specialty for shop making small machinery. Will sell all or part interest. Box 836, AM. M.

For Sale—A solid brick, steel construction, factory building, with 7½ acres of land near Chicago. Now unoccupied. Size 110x541. Suitable for iron working business. Has engine, boilers, dynamos, etc. Most favorable prices and terms will be given. Chicago Highlands Association, 1315 Wells Building, Milwaukee, Wis.

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A Modern Metallurgical Laboratory

Apparatus Used and Methods Employed in the Chemical, Mechanical and Microscopical Departments of De Dion-Bouton Works Laboratory

BY A. M. PORTEVIN*

The extraordinary development of the automobile industry during the last few years has had a remarkable effect on metallurgy. This effect has been caused by the necessity of producing special steels and alloys by combining properties which up to now have been thought to be essentially separate and irreconcilable; for example, to produce metal which after hardening will have a high tensile strength and at the same time be very tough.

The materials used in motor-car construction have to withstand exceptional stresses and the materials used in ordinary engineering practice are not nearly strong enough to withstand such stresses. These requirements have caused several makers to install laboratories which are used both for research work and as a means of control.

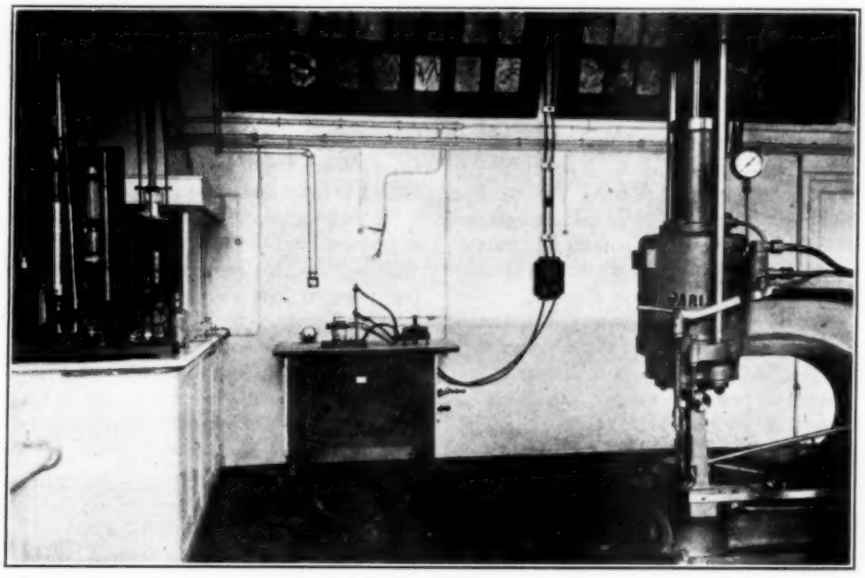


FIG. 1. LEFT TO RIGHT: WIBORGH'S APPARATUS FOR MEASURING THE QUANTITY OF CARBON; TAUMANN'S ELECTRIC FURNACE; FREMONT'S PUNCHING MACHINE

Without any doubt, the laboratory of the De Dion-Bouton Company, of Puteaux, France, ranks among the first of such laboratories not only because it was the first to be installed, but also because very important results have been obtained there. In fact it was in this laboratory that the remarkable investigations on special steels, which are known by all those who are interested in this question, were made by Monsieur Léon Guillet, who is the director of this laboratory.

On account of its scientific arrangement and the special apparatus that it contains, this laboratory is an interesting type of the laboratories of this kind, as it gives a very good example of the means of control and research put at the disposal of metallurgists by modern scientific methods.

The laboratory is divided into three parts and according to three principal methods of investigation, namely: A laboratory for analysis and chemical tests; a laboratory for mechanical tests, and a laboratory for microscopical analysis.

Other tests, i.e., thermal tests, such as hardening, annealing, and tempering, and physical tests, such as transformation point, electrical resistance, melting point, etc., are also often made, but there is not a special part set aside for this, as the necessary apparatus is situated in the chemical and mechanical laboratories.

Chemical Laboratory

It is very useful and even indispensable in many cases to know the chemical composition of the steels and the alloys used in the construction of motor cars. The use of special steels and brass mixtures calls for a thorough knowledge of the elements which they contain; therefore, it is necessary to be able to verify the exact composition usually contained in the steels, that is, carbon, silicon, manganese, phosphorus, sulphur, and also the elements specially added, such as nickel, chromium, tungsten, vanadium, etc.

The plant for this work is situated in two special rooms and employs five chemists. In the middle of the larger room is a table for electrical analysis; this method is held in high esteem because of the exactitude and the rapidity with which results can be obtained. The electrical plant is furnished with special rheostats, also with switches for the ammeter. The other room contains stoves, water-baths for heating purposes, calcining furnace, etc. Finally there are 16 positions which can be used for analyzing purposes, the current being supplied by two special accumulators.

The convenience of this method of analyzing bronze, brass and other alloys is well known. Two other rooms are also occupied, one for investigations for considering the volume of the metals and the other for investigation by weight.

This installation suffices to verify the composition of different pieces of steel, bronze, brass and anti-friction metal, also to analyze lubricants, combustible material, gases, etc.; in fact all the chemical work which is required for the works.

The investigations made with regard to different steels and alloys necessitate, among other things, two pieces of apparatus which we will describe, as they are peculiar and very interesting. These two pieces of apparatus serve to determine the melting points of alloys and the transformation points of different steels.

Transformation Points of Different Steels

It is well known that steel when cooling is subject to one or several internal changes during which heat is given off rapidly and the structure of the metal itself changes. To know the temperature at which these changes take place is very useful, for it is the base of the treatment, by heating, to which the steels are to be put.

The apparatus used is LeChatelier's galvanometer, a Heraus electric furnace, some thermo-electric couples and a Mariotte's vessel.

The specimen is heated in an electric furnace, Fig. 1, which is furnished with a resistance. In this the piece to be tested is placed, after it is soldered to a wire consisting of two metals that form a couple. The metals used are platinum and a mixture of platinum and iridium. A second couple, of the same metals, is joined to this solder, which is then common to both couples.

*Chief chemical engineer, the de Dion-Bouton Works, Puteaux, France, and editor the *Revue de Metallurgie*.

The piece of metal which is used for purposes of comparison is joined to one of the above couples and also to a platinum wire, so that the wires which are connected to the double galvanometer are at one side a compound wire, made of platinum and platinum mixed with iridium, which gives the temperature of the piece being tested. At the other side the two platinum wires give the difference of temperature between the piece being tested, and the other piece mentioned above which is used for this comparison.

This test consists of heating specimens, in a Heraus electric furnace, up to a certain point and then allowing them to cool slowly. It is done completely automatically by means of a liquid electric resistance, formed by two sheets of iron that are placed in a tank, into which water is run from a Mariotte's vessel. The flow of water can be regulated according to the speed with which one wishes to heat the specimen. A siphon is also provided to regulate the overflow of the tank and this regulates the speed at which the furnace cools down. The specimen during the determination of these transformation points is as far as possible kept in an atmosphere of nitrogen.

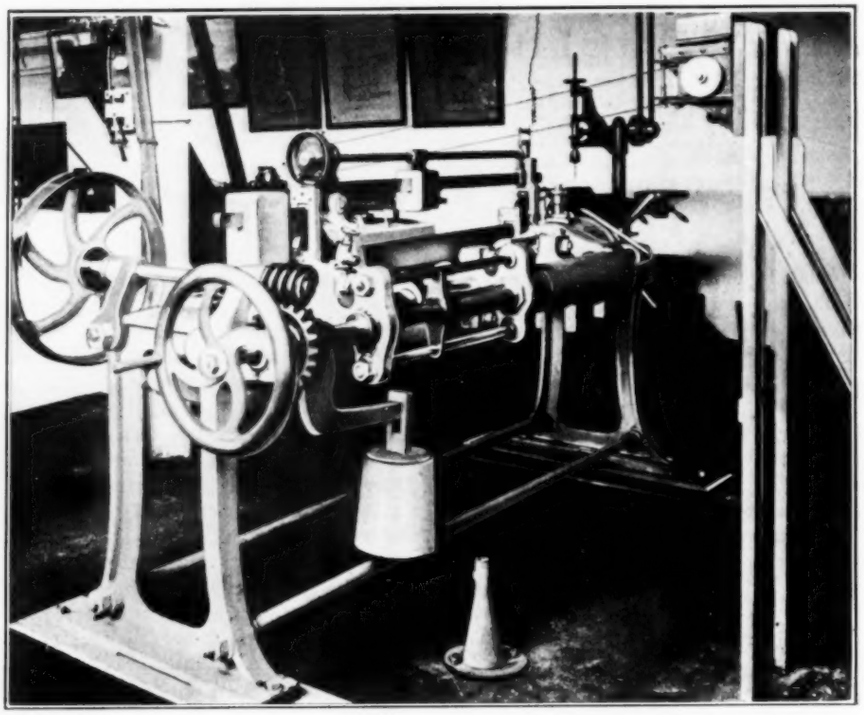


FIG. 2. MACHINE FOR TESTING THE TENSILE STRENGTH OF METALS

Melting Points of Alloys

Modern investigations made on the composition and properties of alloys have shown that to study this subject in a proper manner it is necessary beforehand to make a diagram of the melting points. That is to say to draw a curve, which shows, in comparison, the temperatures at which the alloys commence and finish solidifying, and also the temperatures at which the alloys change while cooling. In this the composition of the alloys should always be kept in mind. The outline of the curves obtained, during the cooling, which is the base of these calculations and therefore important, is obtained automatically by means of a registering machine constructed by Messieurs Richard.

The thermo-electric battery which measures the temperature of the alloy is regulated to suit a Desprez d'Arsonval galvanometer on the mirror of which are shown some vertical rays of light. The light is reflected through a horizontal slit behind which a roller covered with sensitive photographic paper turns on a horizontal axis by means of clockwork.

To melt alloys, whose melting point is not above 1200 degrees, a Ferquignon furnace is used; for those alloys whose melting point is not above 2000 degrees the furnace invented by Professor Taumann de Gottingen is employed. This furnace, which is shown in the middle of Fig. 1, consists of a non-conducting carbon tube, into which an electric current is passed up to 400 amperes at 10 volts. This necessi-

FIG. 3. MECHANICAL TESTS; EXTREME LEFT, LE CHATELIER'S HARDNESS TESTER; CENTER, R. GUILLERY'S MACHINE FOR TESTING BRITTLENESS; RIGHT, GUILLERY'S HARDNESS TESTER

tates the use of a transformer which is placed in a frame, that is fastened on the table which carries the furnace. Closed tubes, made of a special porcelain, or of oxide of magnesium, containing the pieces which are to be melted, are placed in the vertical carbon tube.

This furnace is very conveniently operated by means of a rheostat and 50 pounds of pure iron can be melted in it in 15 minutes.

THE LABORATORY OF MECHANICAL TESTS

Three fundamental tests must be made to determine the tensile strength, brittleness and hardness of any steel before it can be properly considered as a material to be used in the construction of motor cars. To these tests have been added tests by compression, shearing, punching, bending, etc., and finally tests by heating.

a pointer, the latter moving in proportion to the advance of the weight which balances the stress on the specimen. This movement is obtained automatically by means of a small electric motor which acts on the weight and consequently the pointer. If the equilibrium between the weight and the stress on the specimen is broken the motor is automatically cut out of circuit.

The test of brittleness of the specimen is made by means of a sharp blow, using a small bar which has been devised and brought to perfection by Messieurs Le Chatelier, Harpy, Fremont, Barba, Leblanc, etc. The kinetic energy required to break the testing piece is determined and thus a measure of the fragility of the specimen is obtained.

At the De Dion-Bouton works two different kinds of apparatus are used to

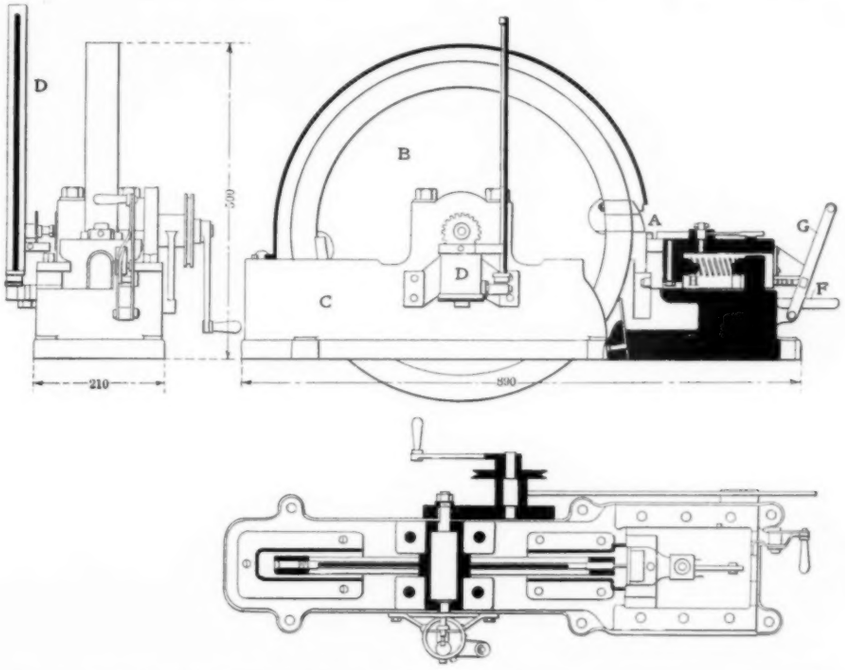


FIG. 4. GUILLERY'S MACHINE FOR TESTING THE BRITTLENESS OF DIFFERENT MATERIALS

We will say only a little with regard to the first: The test by tension is now made universally and it is even used as the base to distinguish the different grades of steel.

The Delaloé testing machine for making tensile tests, as shown in Fig. 2, shows on a diagram the elastic limit and the breaking point. These, together with the increase in length of the specimen, are the three results to be obtained by a test of this kind. When the elastic limit is wanted with accuracy Fremont's conical test pieces are employed in connection with Fremont's special machine, Fig. 6, for determining the elastic limits of metals. We will speak further of this machine later on.

The amount of the elongation of the specimen is recorded in the usual manner. The stress put on the specimen is shown by an indicator which is furnished with

make this test. One of these is Fremont's machine, which is shown to the right in Fig. 1. In this the rupture of the specimen is produced by means of a tup that falls from a certain hight and is guided between slides. As the velocity of the tup at the moment that it strikes the specimen and the kinetic energy are constant, it is only necessary to determine the kinetic energy remaining after the blow.

This kinetic energy is absorbed by some Belleville elastic washers that are connected up to a pointer, which indicates the amount by which they are compressed, and, therefore, at the same time it indicates the amount of kinetic energy remaining in the tup after the blow.

The second one, Guillery's machine, consists of a flywheel of steel fixed on a horizontal axis that carries on the rim the cutting tool, as shown in Figs. 3 and 4. The variation in the kinetic energy resulting from the rupture of the specimen is measured by the reduction in velocity of the tool. This velocity is obtained by means of a tachometer. The flywheel is made to turn, either by hand or power, at such a speed that the force accumulated in the flywheel is greater than that which, in any case, will be necessary to break the testing bar.

The velocity at the point of impact is equal to the velocity which has been used up to then, for these tests; that is to say, the velocity which corresponds to a clear fall of 13 feet. The drive is obtained

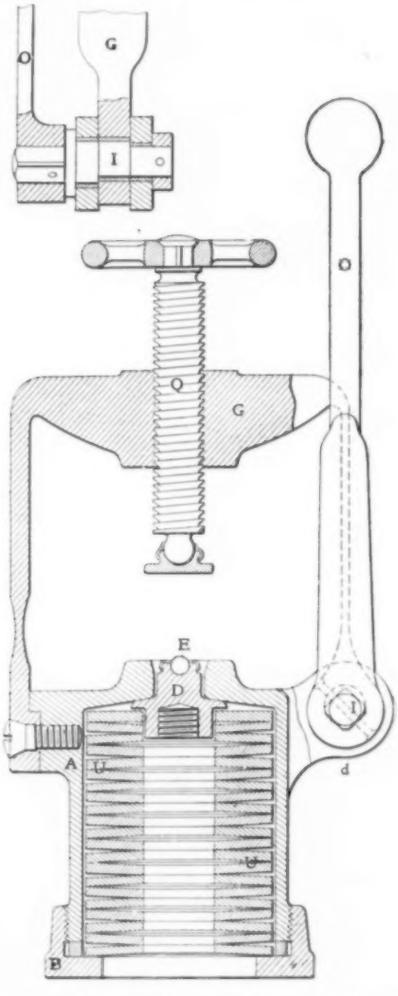


FIG. 5. GUILLERY'S MACHINE FOR TESTING THE HARDNESS OF MATERIALS

by the use of a friction clutch, which is put in or out of action by means of a lever. This lever is fastened to the frame of the machine when the clutch is disengaged. If the lever is unfastened a spring, provided for the purpose, tends to draw it into action in such a manner that the flywheel gradually begins to turn faster and faster until the normal speed is reached. The machine can be turned by hand or by means of a rope drive; the grooved pulley for this drive can be seen in the illustration.

The test bar is placed between a pair

of light dogs on a movable anvil of cast steel and a hardened cast-steel plate is let into this anvil on the right-hand side of the center and a powerful cylindrical spiral spring is provided to press against the anvil in the direction of the flywheel; that is, it tends to place the anvil in the position necessary so that the tool in the flywheel may strike the specimen held in the anvil.

The mechanism to place the anvil and, therefore, the test bar in this position consists of a cam mounted on a shaft so shown in Fig. 3, is used. This apparatus is fitted with an indicator which gives a diagram of the test.

For ordinary tests Guillery's apparatus, shown in Fig. 5, is used. This consists of a steel cylinder *A*, screwed into the foot *B*, and containing the Belleville washers. The pressure on the washers is transmitted to the ball *E* by means of the piece *D*. This arrangement serves to measure the pressure under which the ball has been pressed into the metal to be tested.

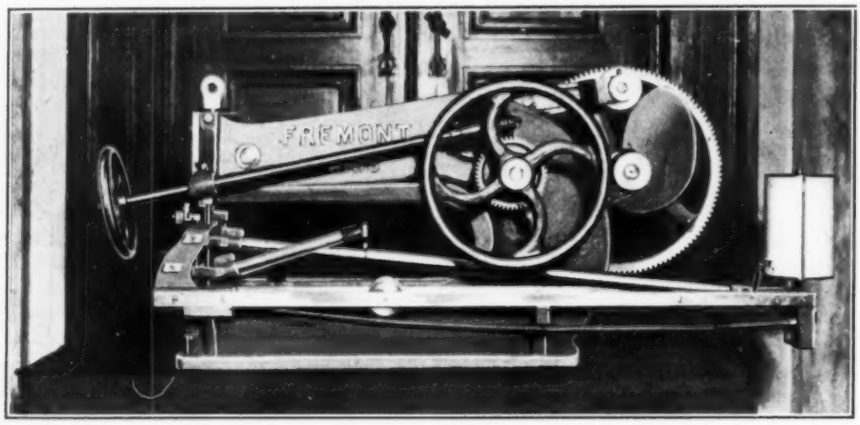


FIG. 6. FREMONT'S MACHINE FOR BENDING AND SHEARING TEST AND ALSO OBTAINING THE ELASTIC LIMIT OF METALS

that it turns with the shaft but is free to travel lengthways along the shaft. The shaft is provided at one end with a latch and also a spring which is always tending to put the cam into action and draw the shaft toward the operation.

When the operator, by means of a lever fixed in part of the apparatus, draws the anvil toward him the spring turns the cam and this leaves the anvil ready to be pushed into position by means of the cylindrical spiral spring. The action of this arrangement is instantaneous, and when the tool has made a complete rotation it strikes the test bar with full force.

The tachometer consists of a small vertical centrifugal pump which indicates the speed, at any instant, by means of the level at which it keeps the head of water in a graduated tube. In this way the speed can be accurately read off at any instant. The machine is also provided with a safety arrangement, so that it is impossible to place a test bar in position, or even to move the dogs when the anvil is not held back by the cam and spring arrangement.

Testing the Hardness of Materials

The hardness of metals is determined by measuring the diameter of the imprint left on the plane surface of the metal, when a hard-steel ball of the Brinell type is given a certain predetermined pressure. For very soft or very hard metals, Monsieur Le Chatelier's apparatus, as

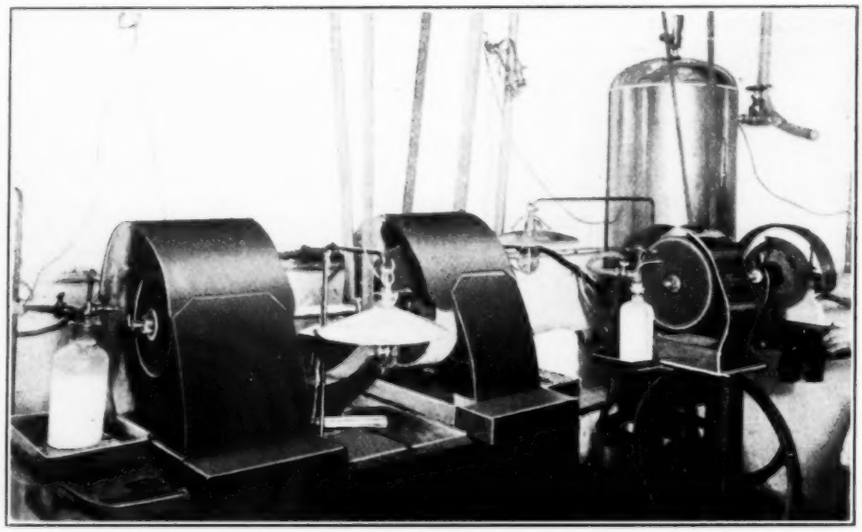


FIG. 7. POLISHING ROOM

Extending above this is a lever which presses the test plate on the ball until a sufficient pressure is reached to flatten the washers, which causes the ball to disappear. The press is formed by the stirrup frame and the wedge screw *O*, which serves to transmit the effort but not to exercise pressure, because when the test plate and the ball are touching the friction rendered makes it impossible to tighten up the wedge screw *O* any further. At one side an eccentric shaft *I* is passed through one of the ends of the stirrup frame *G* and at the end of the shaft is fixed a lever *O*. The eccentricity of this shaft is 0.059 inch and, therefore, it follows that if the lever *O* is rotated through an angle of 1800 degrees the test plate is lowered by this amount. This operation is continued until the ball cannot be further pressed into the plate. Then it is certain that the imprint has been obtained by a pressure which has resulted from compressing the springs from their normal position through a distance of 0.059 inch. That is to say, the pressure is absolutely constant.

The measurement of the imprint left is made either by means of a vertical microscope which can be moved horizontally by means of a micrometer screw that is fitted with a graduated collar so that the cross hairs can be adjusted tangentially to the edges of the imprint, or it may be more simply measured by means of Le Chatelier's rule, with which one can with certainty measure 0.004 inch with the naked eye.

It is well known that for ordinary steels the hardness of the metal is in proportion to its tensile strength and in certain cases, to obtain results in a short time, the test of the hardness of the metal can be made instead of testing the tensile strength. In this there is the advantage of being able to test the hardness at any point of the test piece.

Fremont's Machine for Testing Elasticity

Besides the above three main tests, other complementary tests are also made and in certain cases these complementary tests are made instead of the first three. There are two pieces of apparatus made by M. Fremont that are used for these complementary tests, which we will describe very briefly.

This apparatus is shown in Fig. 6. It can be used in compression, bending or shearing tests and furnishes the results in

the form of a diagram showing the changes in form of the specimen as abcissal and the changes in length as ordinates. It also shows with great accuracy the elastic limit of the specimen and this point is particularly important when certain nickel and manganese steels are under consideration.

The principle on which the above determinations are based is as follows:

If one places under tension a highly polished specimen, which has previously been made in the shape of the frustrum of a cone, and applies pressure until the tension at the smallest section of the specimen being tested reaches the maximum value per unit area that the specimen can withstand, then at this moment it is evident that there is at some certain point of the specimen a greater section where the tension per unit area will not have passed the elastic limit.

FIG. 8. MICROSCOPE ROOM WITH LE CHATELIER'S MICROSCOPE

This point can be determined, after the rupture has taken place, by means of the fact that the polish will have remained perfect up to this point on the surface; as the specimen up to this point has been elastic and returned to its original form.

To obtain the elastic limit of the specimen in pounds per square inch, the total effort in pounds is divided by the section in square inches, taken at the point where, on the surface, the part of the specimen which has retained its original polish meets the part on which the polish has been destroyed.

In particular it is to be noticed that the shearing test can replace the tension test for ordinary steels. In fact M. Fremont has shown that given the shearing diagram, the tensile strength, the elastic limit and the reduction in diameter of the specimen before it actually breaks can be calculated. But our personal experience has shown that the formula which he gives does not apply when special steels are being considered. Also for a shearing test one can use smaller test pieces and the experiment can be repeated several times with the same piece.

Fremont's punching machine, shown on the right of Fig. 1, is based on the same principle as his machine for determining the elasticity of materials; but the former is much more powerful and is used specially for punching and bending tests.

Thus the mechanical laboratory is used to determine:

First: The tensile strength, the ductility, and directly the elastic limit of different metals by means of tension, shearing and punching tests.

Second: The brittleness of materials by means of subjecting the specimen to a sudden sharp blow.

Third: The hardness of metals by means of Brinell's ball system. These tests can in a certain measure, in particular cases, replace more or less completely the tension test.

The experiments should be made both with an annealed piece of the metal to be tested and also with a hardened piece.

For hardening, Charpy's well known electric furnace is used, the heat being obtained by passing an electric current through a spiral of platinum wire. This furnace is made to tip over into a tank of either water or oil as the case may be.

The Laboratory for Microscopical Tests

This is composed of two rooms, namely, the polishing room and the microscope room.

In the polishing room 3540 samples are polished each day. The piece is first roughed out on a carborundum wheel, and then lightly passed over an emery wheel of coarse grain and finally the surface which is to be examined is polished by using a series of emery paper No. 0000 and emery powder No. 000. The emery papers are obtained from a firm that makes a specialty of this work and it furnished them with the grain sufficiently regular for our requirements. The emery paper is placed on the surface of a thick piece of glass, and kept in position with one hand, while the piece of metal is moved up and down on the paper with the other hand.

In order to obtain a rapid polish the test piece should be polished on one paper in one direction and on the next paper at right angles to the first direction, so that the second paper will tend to efface the lines cut in the surface of the test piece by the first paper. The action of the emery paper can be hastened by wetting it with turpentine, or it can be slowed down by using some grease.

When this operation is finished the test piece is polished with alumina on disks which are turning at a high speed. The disks used are made of very dry wood on which is fastened a level disk of zinc and finally a thick piece of cloth is stretched over the whole surface. The cloth must previously be well washed and rubbed to get rid of impurities. The thickness of the cloth is important and it should also be well stretched.

At first the polishing is done with two hour alumina, then with four hour alumina and if necessary with even still finer alumina. To obtain the very best results the alumina should be placed in suspension in water and then sprayed on the work. In this way the powder is very evenly distributed.

The room which is exclusively reserved for finishing is shown in Fig. 8. The roughing and the polishing with emery paper are done in another room, so as to avoid any chance of the grains of emery getting on the pieces of cloth which are stretched on the polishing disks. Four such disks are shown in Fig. 7 and the difference between them is in the quality of alumina employed. Two of these are used with four hour alumina as this is most frequently required.

Ordinary polishing spindles are used which are fitted with a belt drive from a variable-speed motor. The usual speed at which these disks are run is 800 revolutions per minute. Under each disk is a large tray of water to receive the dust which is produced, and besides this the floor of the room is covered with oil. The walls, which are covered with a Ripolin paint are kept as clean as possible. Only the polisher is allowed to enter this room.

An air compressor, which supplies all

the laboratories, also supplies the air necessary to work the sprayers.

With this plant steels can be polished in 10 minutes, the hard alloys of copper in 20 minutes, and for the soft alloys a half hour only is necessary.

The Microscope Room

The microscope room, shown in Fig. 8, is used to examine with the aid of the microscope and also to photograph the polished specimen. The Chatelier microscope is the one used as its use is now practically universal. Auer's burner is used as an illuminant, by which the specimens can be examined and a Nernst lamp, fitted with two large filaments, each consuming one ampere, is used for taking the necessary photographs. It is not necessary to say how useful these microscopical investigations are for a firm like De Dion-Bouton.

The rapidity with which results are obtained and the important information which they furnish, not only with regard to the thermal treatment, but also with regard to the composition of metals, are such that these investigations are constantly being made either for testing before giving the formal receipt for raw material; or for foundry purposes; or for tests in tempering hardening steel; or to determine the exact cause of any breakage that may have occurred.

By using the microscope general rules based on scientific fact can replace the rules of thumb and the particulars which are given are used as instructions on how to work different steels. One may say that microscopical investigation has precedency over any other method of investigation in what concerns steels, either for obtaining quickly any information in simple or urgent cases or for finding the best method in which to make subsequently any desired research.

The preparation of test pieces for mechanical tests is done in a workshop in which are located a drilling machine, a lathe, a shaping machine and a power saw.

The description of this laboratory as a means of control and research, gives an idea of the accuracy and the importance of the investigation made. Some engineers who are accustomed to work by routine do not deign to more than very superficially consider this question of laboratory work, but simply use it as a luxury which can be used as an advertisement. But without any doubt this laboratory work has contributed largely to the success and to the worldwide reputation of the De Dion-Bouton make of motor car.

Machining Some Odd Shaped Pieces

It often happens that the design of a machine involves some difficult machine operations in the building of it, and the Sturtevant blower shown in Fig. 1 is an example of this. The machining of the idler wing and the impeller plate are both more difficult than the ordinary machine shop operations and the methods used are shown in Figs. 2, 3 and 4.

The idler wing consists of a three-lobed casting which must be faced on each end, turned on the outside and grooved in the center to allow the central web of the impeller blade to run in this groove as seen in Fig. 1. While this is not a metallic contact, it requires a good job to prevent too much clearance at any of the points named. Fig. 2 shows the tool used in grooving which, on account of the large overhang required is supported by the stud shown. The cutting tool itself is inserted in the end of the long bar and held by the set screw shown. The wing is driven by the stud at the left which is wedged into the opening to prevent any chatter or backlash.

The machining of the impeller blade is essentially a boring mill job as shown in Fig. 3. It is held by the long bolts running through the cored hole in the blades which hold it firmly to the table as well as driving it.

The hole is bored in the hub, the outside of the hub turned off, the inside of the blade bored to the required diameter, and the outside turned in a similar manner. In addition to this the web is faced around the hub, as can be seen in Fig. 4. As shown in Fig. 3, the first end has been machined and the piece has been reversed on the guide plate, strapped to the boring-mill table. The raised hub on this plate centers the blades, and the main operations are performed on the other end of the blades. As shown, the tools are at work boring and turning the inside and outside of the blades respectively, and as any machinist who has tried it knows, intermittent cutting of this kind is not the easiest work to perform satisfactorily.

After the boring-mill operations on the impeller are completed, it goes to a special milling machine, shown in Fig. 4, where it is mounted on an arbor, held in the bearings shown, and the outer portion of the sides of the web are milled down to the same thickness of the faced portion surrounding the hub. The small jack in the foreground holds the impeller steady during the milling operations.

The surfacing of the web was formerly done on a special shaper, designed and built for this purpose; but the milling machine shown has proved to be much more satisfactory in every way. Fig. 4 also shows the cored holes through the impeller's blades, fitted with threaded caps.

Referring again to Fig. 1, we see that the impeller's blades revolve around the stationary core which fills the space between the inside of the blades and the hub. This core forms the abutment or contact with the idler while the impeller's blade itself acts in conjunction with the lower

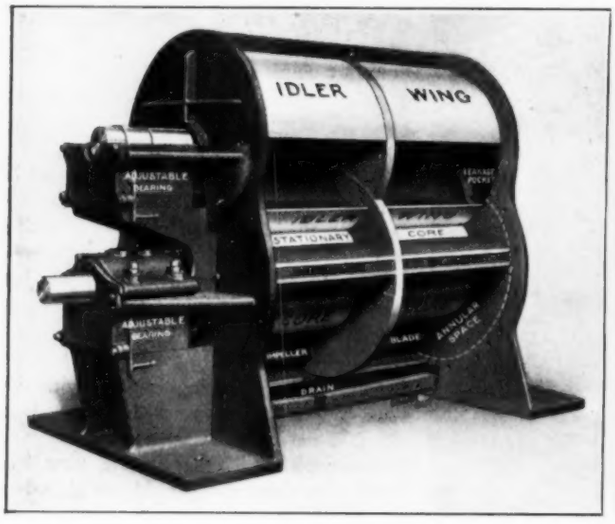


FIG. 1. WHERE THE PIECES GO

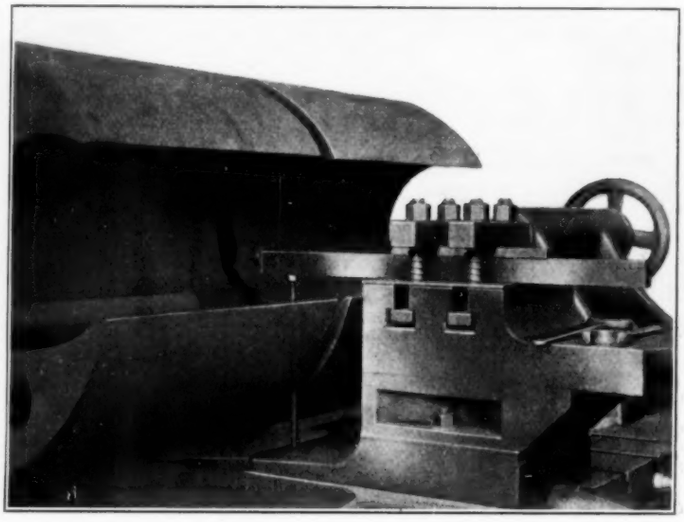


FIG. 2. CUTTING THE GROOVE

case, the pocket in the idler wings allowing it to pass by without making contact. A crescent-shaped shoe fits in the groove in the center of the idler wing and makes the joint with the web of the impeller.

Altogether these make an interesting job in machine-shop work, and we are indebted to the B. F. Sturtevant Company, Hyde Park, Mass., for the photographs and information in connection with them.

American Patents—Few are Declared Invalid

By H. G. Ward

It has recently become known that criticism has been made of the Patent Office in some quarters, on the ground that it grants too many patents which, on due investigation in the courts, are held to be invalid. A careful investigation of the matter has brought to light statistics which show that this criticism is entirely unwarranted. In order to correct any misapprehension on the subject which may result from permitting such statements to remain unchallenged, Commissioner of Patents Moore has given a correspondent of the American Machinist the following official statement of facts, which cannot fail to interest inventors and manufacturers in every line of industry:

"The work of the examining corps of the Patent Office consists principally in searching the art to determine the novelty of inventions for which applications for patent are made," said Commissioner Moore. "The number of United States patents issued up to December 1, 1908, is 905,825. There are also about 1,500,000 patents of all countries, which are obtained by exchange with the countries belonging to the International Convention for the Protection of Industrial Property. It is, therefore, seen that the fields of search to determine the novelty and validity contain nearly 2,500,000 patents.

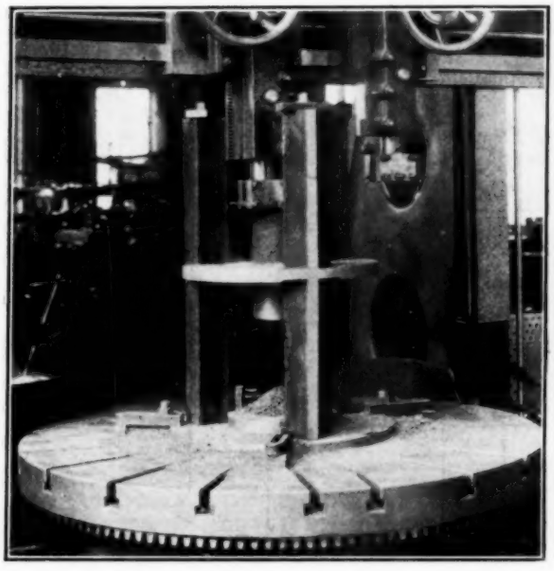


FIG. 3. BORING THE IMPELLER

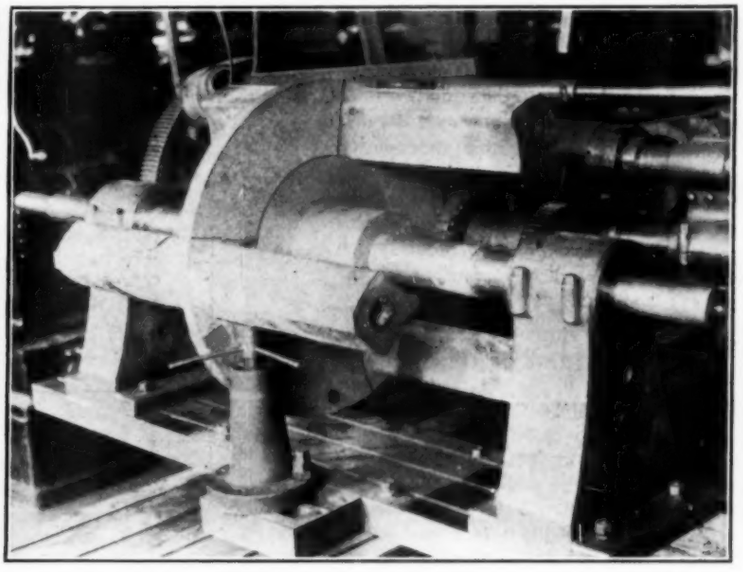


FIG. 4. MILLING THE DISK

Patents Held Void in 1900

"For years past the force of examiners provided by Congress has been able to keep the work of examination from falling hopelessly behind only by continually working under a pressure which must inevitably result in some few mistakes being made, but these mistakes are comparatively few as is shown by the fact that only a very small proportion of the patents granted have been held void in the courts. In the year 1900 only seven patents, or 0.026 of 1 per cent., of the patents granted in that year were held void. It must be borne in mind that patents which are clearly valid are rarely brought into suit, for the reason that infringers are not willing to risk the result of the suit. For this reason only patents which are of a doubtful nature on the question of patentability are involved in suit. It has been for an indefinite period the policy of the law, as construed by the various officials of the Patent Office, to resolve doubts on the question of patentability in favor of the applicant. In view of the fact that doubtful cases of patentability are resolved in favor of the applicants, and in view of the fact that as a general rule only those patents which are of a doubtful nature are brought in question in the United States courts, it is not surprising if some of them are held invalid. On the other hand, it is rather surprising that out of the total number of patents granted such a small number of them are successfully attacked.

"There are many defenses which may be interposed in a suit in the Federal courts which will result in avoiding a patent which cannot under the law be investigated in the United States Patent Office in deciding the question whether the patent shall be granted. A notable example of such a defense is that of prior knowledge and use. It often appears from evidence submitted in suits on patents that the device of the patent in suit was known prior to the invention of the patentee or was in public use for more than two years prior to the filing of the application on which the patent was granted. These are matters which cannot ordinarily be investigated by the Patent Office, the procedure in securing a patent in a majority of the cases being an *exparte* proceeding, no one outside of the applicant and the Patent Office having any knowledge of the claims of the inventor while the application is pending. In some few cases, however, where third parties have become advised of the fact that they have been placed in interference with other applicants or by the advertisements of these applicants, or have come to the knowledge of the fact that applications are on file through their business relations with those applicants, their information is given to the Patent Office of the fact that a bar of two years' public use to the invention exists. In such cases where the facts warrant it the commissioner institutes public proceedings and requires testimony to be taken in substantiation of the allegation of public use. Cases where public use proceedings are instituted, however, are very few compared with the number of patents issued.

Applications and Patents in 1907

"The number of applications filed last year for patents was 58,762, and the number of patents issued was 36,620. On this work there was provided by Congress an examining corps consisting of substanti-

ally 300 persons. Most, if not all, of the applications for patent are not found in condition for allowance upon the first examination, and therefore a great many of these applications, the number of which increases year by year, have to be re-examined a number of times. The records show that each week, in order to keep the work uptodate, it is necessary to act upon an average of 1100 new applications and from 3500 to 4000 amended applications. When it is considered that there are about 265 working days, deducting Sundays, holidays, and time allowed for annual leave, it is apparent that each examiner must examine and finally determine the questions of anticipation, of novelty, and validity of the patent for which application is made in an average of three applications each day. When it is remembered that the large number of actions required by the examiners of the Patent Office necessitates a very much more limited search of the prior art in granting patents than is made by attorneys in investigating the novelty or validity of a patent when the same gets into litigation, it is readily seen that the work of the examining corps is done in a manner which should be subject of commendation rather than criticism. Comparatively few patents of those granted are found to be anticipated by the prior art which was available to the examiner when the search was made prior to the granting of the patent.

Personnel of the Examining Corps

"During the last year with the help and approval of the Secretary of the Interior, Congress granted an increase of 33 men in the examining corps and made a substantial increase in their salaries. This increase in salaries will, it is hoped, check the vast number of resignations of the examining corps so that the Patent Office will have the benefit of the continued services of experienced men. The low salaries which have been paid the examining corps resulted in a continual depletion of the force so that its effect was very noticeable. Within the last few years it has been difficult to retain men of experience in the service of the Patent Office. In the entire grade of fourth assistant examiners, which is the grade in which the examiners enter, no one of them had been in the service for a greater period than one year. Another great reason why the work of the Patent Office is hampered is the lack of room and facilities for performing the work. Congress has been urged this year to provide a new building for the Patent Office with modern equipment, in order that it may be in a position to properly do the work for which the inventors of the country pay more than the entire expense. Since the Patent Office has been in existence nearly $7,000,000 of surplus have been paid into the United States Treasury over and above all expenses, including salaries, which have been charged against the Patent Office."

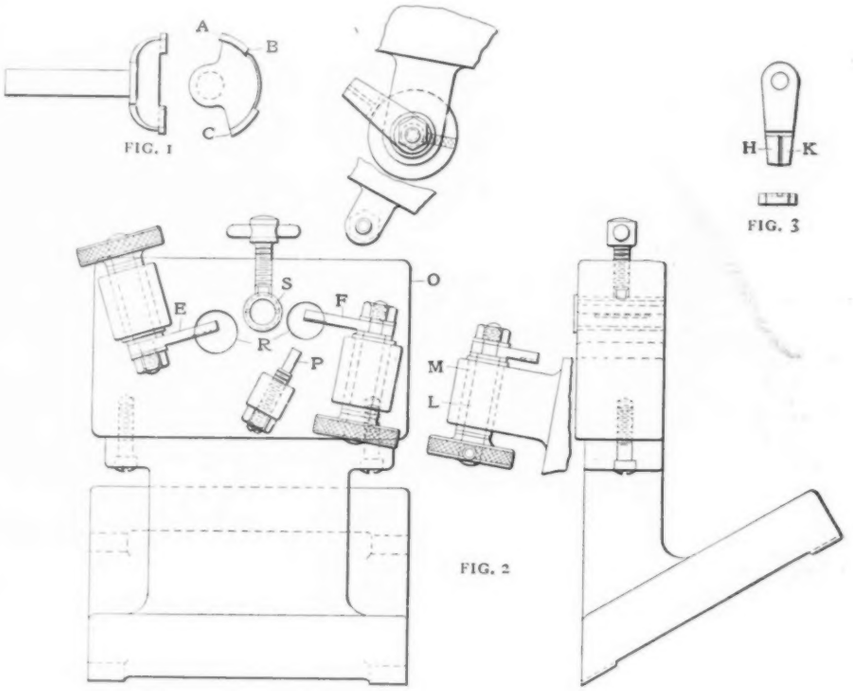
A Gaging Fixture

Fred R. Carstensen

The accompanying sketches clearly illustrate an exceedingly sensitive gage, the principle of which may be used when it is desired to gage more than one point at the same setting. Fig. 1 shows the work; *A*, *B* and *C* are the points to be gaged.

Fig. 2 illustrates the gage, *E* and *F* are swinging arms on which the limits are placed. Fig. 3 is a detail of arm *E*. The surface *H* is ground lower than the surface *K*, the amount desired as a limit. Shaft *L* and bushings *M* and *S* are hardened and ground. Bushing *S* is split as may be seen from the illustration. The base *O* is cast iron. The holes *R* are drilled through so that the user may see the point of contact between the gage and work to better advantage. The fixture is made to set at an angle with the bench to relieve the strain on the eyes of the operator which is caused when he is compelled to look on a horizontal line.

The work is held by the shank in the bushing *S*. Point *B* is brought against stop *P* and the work then clamped in position. It is then merely necessary to swing down arms *E* and *F* over ends *A* and *C* to see if the work is within the required limits.



A GAGING FIXTURE

Commission on Re-inforced Concrete

It is expected that considerable progress will have been made by the International Commission on Reinforced Concrete when it assembles in September, 1909, at Copenhagen in connection with the International Convention of the Association of Testing Materials. Representatives of all the important European countries are already enrolled in this commission, and it is expected that the United States will also be shortly represented. At a recent meeting, held at Basle, called by Professor Schule, of the Zurich Technical College, who is at present chairman of the commission, the work it contemplates was divided into four sections: First, the preparation of a summary of tests completed in different countries; second, the preparation of a summary of the facts definitely established by these tests; third, a summary of the chief causes of difference of opinion on the question relating to reinforced concrete; and fourth, the preparation of a set of standards for future tests. A committee has already been appointed to look into the matter of standardizing algebraical notations and the methods of testing.

The English Admiralty have experimented with an ingenious device constituting a small motor air pump for the detection of dangerous gases on board submarines. The pump stationed at an indicator draws air through pipes laid to various parts of the boat, and should dangerous gases exist, warning is given by a delicate recorder.

Design of a Balanced Plunger Elevator

Complete Details Wherefrom Any Machine Shop Can Design, Build and Install a Plunger Elevator Suited to Its Own Needs

BY C. R. HARRIS

In a previous article I showed the possibility of industrial plants using their own machine shops to build short-run unbalanced plunger elevators for their own use. For runs longer than 20 feet it would not, generally, be advisable to install an unbalanced machine. The counterweighted machine costs somewhat more but is more economical and involves very few more difficulties in building and installing.

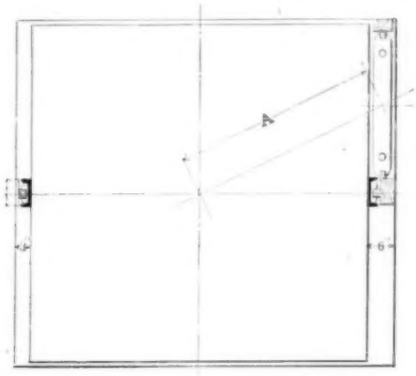


FIG. 1. LOCATION OF COUNTERWEIGHT ON A PLUNGER ELEVATOR

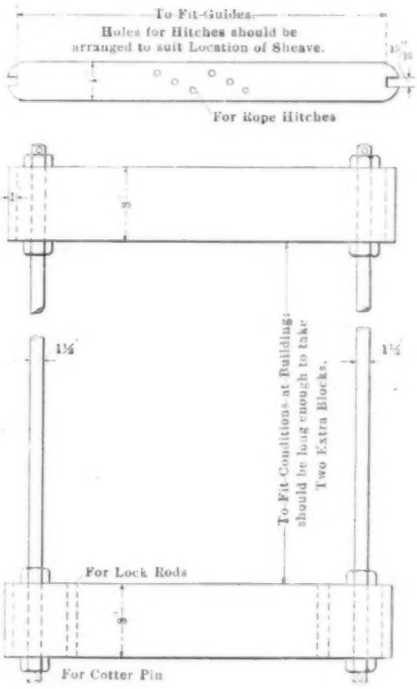

To Fit Guides.
Holes for Hitches should be arranged to suit Location of Sheave.
For Rope Hitches
To Fit Conditions at Building should be long enough to take Two Extra Blocks.
For Lock Rods
For Cotter Pin

FIG. 2. COUNTERWEIGHT DETAILS FOR A PLUNGER ELEVATOR

The location of the counterweight is the first consideration. Fig. 1 shows one of the most common locations. It will be noted that one of the main guide-rail supports, also carries one of the counterweight guide rails. The counterweight guide rails should be maple or poplar (white-wood) $\frac{7}{8} \times 1\frac{1}{4}$ inches in section, spliced the same as the main guide rails.

The Counterweight

Fig. 2 shows the details of counterweight and Fig. 3 the filler block.

All filler blocks and the lower end block should be bolted together after the counterweight is in place to prevent accidents. In case of long counterweights a spacer as shown by Fig. 4 of $\frac{1}{4} \times 3$-inch iron should be made to hold the counterweight rods at the proper distance apart and to prevent the rods from spreading, which would allow the counterweight fillers to fall out.

I once knew of an elevator being built which had a counterweight as shown by Fig. 5. This was encased in a wooden box and ran without guides. It made some noise but not enough to be objectionable in most factories.

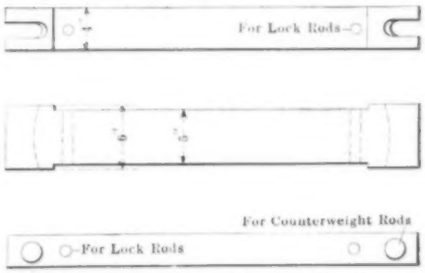
Fig. 6 shows a section of a counterweight sheave wheel. The number of arms will depend upon the diameter of the sheave, and the number of ropes will be governed by the diameter of the sheave and the weight of the counterweight.

The counterweight is made sufficiently heavy to balance the larger part of the weight of the car and plunger. Sufficient weight must be left unbalanced so that the unloaded car will descend at a predetermined minimum speed. The plunger when immersed in water has a tendency to float. The buoyancy is equal to the weight of water displaced; with a $6\frac{1}{2}$-inch plunger this amounts to 14.37 pounds per foot of length.

The Counterweight Ropes

The ropes perform two functions: One to attach the counterweight to the car; the second to compensate for the loss of buoyancy as the plunger rises in the cylinder and to thus equalize the lifting capacity of the elevator throughout its total run. As the elevator rises the weight of the ropes is taken from the car side and transferred to the counterweight side; it therefore follows that the weight of the ropes per foot should equal one-half the buoyancy of the plunger.

The diameter of the sheave will determine the size and number of ropes; the fact that bending of a wire rope about a sheave produces an initial stress in the rope when no weight is attached to the rope must not be lost sight of. The man



FIGS. 3 AND 4. FILLER BLOCK FOR COUNTERWEIGHT AND SPACER FOR RODS

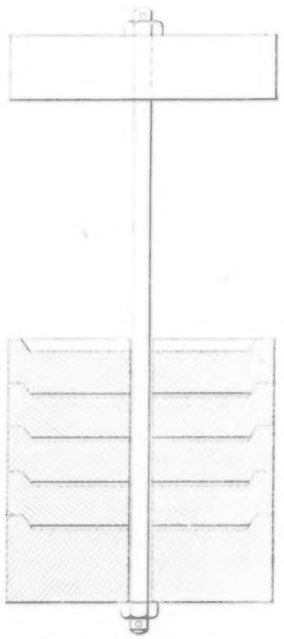


FIG. 5. ALTERNATE DESIGN FOR COUNTERSHAFT FOR PLUNGER ELEVATOR

ufacturers of wire rope are always ready to advise patrons on this point. A properly chosen rope on this type of elevator will run for 30 years without replacement, but I have known cases when too large a rope was used for the sheave diameter; this caused replacement in less than five years. In all cases iron rope should be given preference and used if possible; it has greater flexibility and greater freedom from corrosion. The ropes should be well covered with boiled linseed oil as soon as installed and the application renewed every six months.

Fig. 7 shows a rope hitch for fastening the rope to the counterweight. Enough 5/16-inch bolts are used so that the shearing strength of the bolts is equal to the tensile strength of the shank of the hitch. Care must be taken not to sever the wires of the rope when putting in the bolts; the rope should be opened by a small marlin spike carefully driven through the bolt holes followed by the bolt. Hitches and ropes are designed so that in case of six ropes, two of them would carry the counterweight; in case of a three-rope installation, one rope and hitch should have ample strength to carry the whole load of the counterweight.

The rope when not over 7/8 inch in diameter can be carried under a spool, Fig. 8, fastened between the cross-bars of the car. After passing under the spool the ropes are collected and fastened in line by means of a strap-iron clamp. If ropes larger than 7/8-inch in diameter are used they should be provided with hitches at the car end as well as the counterweight end.

The car used for a counterbalanced elevator would be the same as that shown in Fig. 3 on the short-run or unbalanced machines; the 1/4x6 flat iron cross-bars would be replaced by 6-inch channels and gusset plates added, as shown by Fig. 9. If hitches were used on the car end of the counterweight ropes, the spool would be replaced by a wrought-iron plate, as shown by dotted lines; such a plate should be 1x10x12 inches.

THE CYLINDER AND ITS SINKING

The cylinder for a counterbalanced machine would be so long that digging the hole would be too expensive. If no ledge will be encountered the end of the cylinder should be closed by a sinking head, as shown by Fig. 10. In starting to sink care should be used to place the head on a small flat stone to prevent dirt from closing the end opening.

When it comes to erection the guides should be the first thing put up, care being used to get them plumb. This should be followed by locating and sinking the cylinder. The cylinder should be guided by temporary frames attached to the sides of the well room. Wherever couplings occur they should be pinned the same as shown on the sinking head, Fig. 10. The stuffing box should be closed by the de-

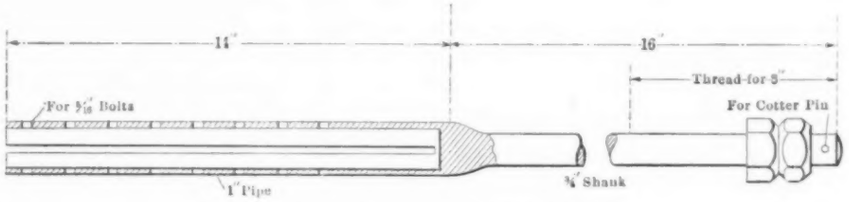


FIG. 7. ROPE END FOR COUNTERWEIGHT ROPE

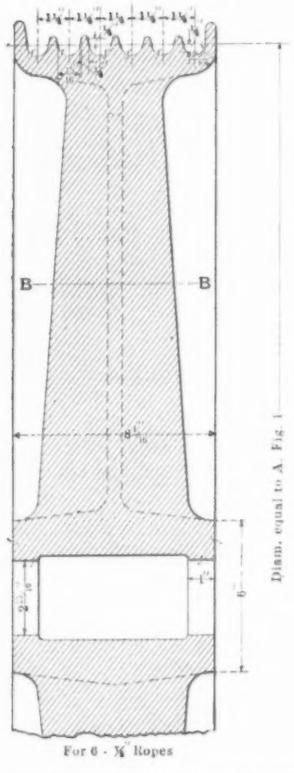


FIG. 6. SECTION OF COUNTERWEIGHT SHEAVE

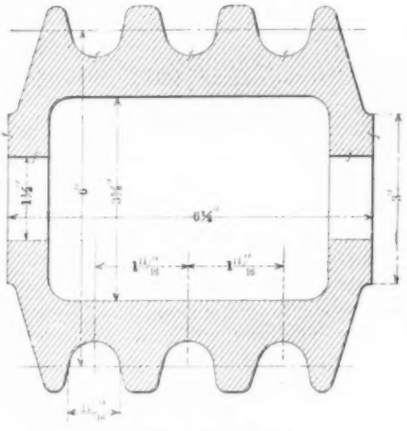


FIG. 8. A ROPE SPOOL

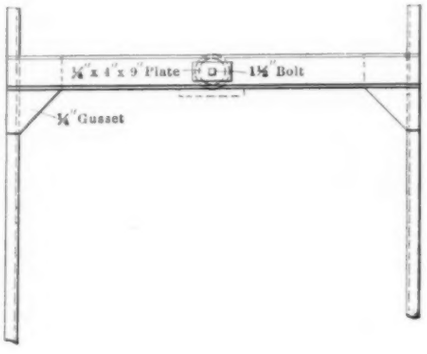
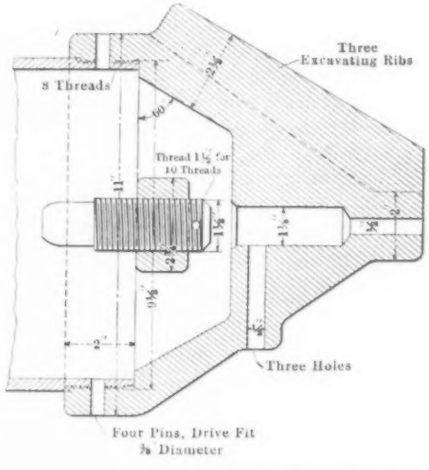


FIG. 9. ARRANGEMENT OF GUSSET PLATES FOR CAR FOR BALANCED PLUNGER ELEVATOR



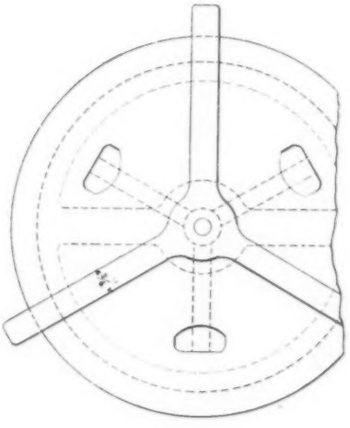


FIG. 10. SINK-HEAD FOR PLUNGER OF PLUNGER ELEVATOR

vice shown by Fig. 11. The screw plug on the sinking head is opened and closed by means of a 1¼-inch pipe wrench. One end is formed square to fit the top of the screw and the other end closed by welding in a rod and forming this to take a wrench.

After the cylinder is placed in the well room the screw plug in the sinking head should be screwed home to close the water passages. Water at not less than 100 pounds gage pressure (if available at 150 pounds it is better) is then carried to the cylinder by means of a 1¼-inch hose attached to the to-and-from opening in the cylinder head. The sinking head had best be placed in a dug hole about two feet deep to start the sinking in its proper location. After the cylinder is filled with water a lever, as shown by Fig. 12, is attached. The water passage in the sinking head is now opened and the cylinder given a rotary motion by means of the lever. The cylinder will descend into the ground from 2 to 10 feet per hour, depending upon the nature of the soil and the water pressure. After the cylinder is down the proper distance the water passage in the sinking head should be closed while under pressure. After the sinking devices are removed the wrench should again be put on the screw plug to insure no leak at this point.

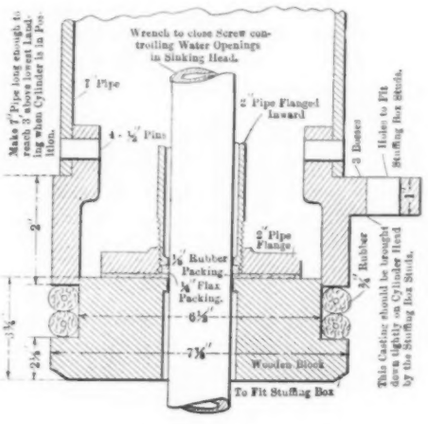


FIG. 11. DEVICE FOR CLOSING THE STUFFING BOX OF A PLUNGER CYLINDER WHEN SINKING

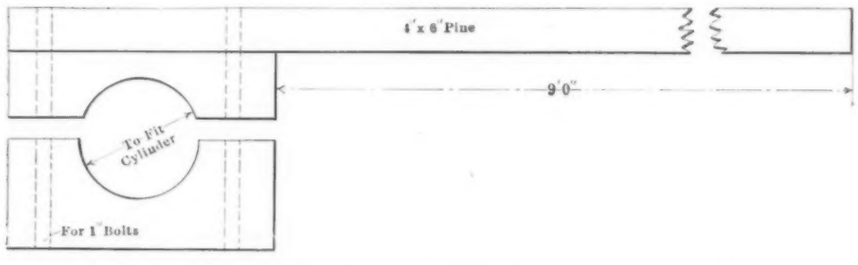


FIG. 12. LEVER USED IN SINKING PLUNGER ELEVATOR CYLINDER

It must be evident that the car platen should not be drilled for the plunger-head bolts until the car is erected in the well room and the holes located from the plunger head. Also that there should be sufficient bolts to carry the weight of the plunger plus the friction in the stuffing box. It is wise to figure the tensile strength of the bolts at a safe working stress not to exceed 2500 pounds per square inch.

An Example

To take an example: Suppose we wished to install an elevator with a 35-foot run to carry a load of 3000 pounds at a speed of 60 feet per minute, having a car 6x6 feet. As a pumping plant is the cheapest method of obtaining the water for an hydraulic elevator, the assumption is made that the water pressure is within our control.

The weight of parts would be about as follows:

	Pounds.
Car	1100
Plunger, 37 feet at 15 pounds	555
Plunger top and bottom	150
	1805
Ropes, 40 feet at 7.2 pounds	288

In coming down with no load—the elevator at the top of the run—it would be necessary to have an unbalanced face large enough to give the required speed and to overcome the friction. The friction would amount to about 350 pounds and the speed requisite would amount to about 300 pounds, or a total of 650 pounds. In other words the counterweight including ropes would weigh about 1150 pounds.

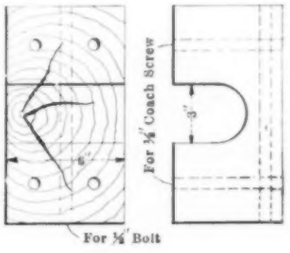


FIG. 13. MAPLE SHEAVE BEARING

In going up with the elevator at the bottom landing we should have to lift:

	Pounds.
Load	3000
Unbalanced force	650
Friction	350
Speed	300
Total	4300

$\frac{4300}{33.183} = 129$ or, say, 130 pounds working water pressure.

For the same run with an unbalanced machine we should have:

	Pounds.
Load	3000
Car	750
Plunger	550
Plunger top and bottom	150
Friction	350
Speed	300
Total	5100

$\frac{5100}{33.183} = 157$, or 160 pounds working water pressure.

The above figures show that the unbalanced machine requires a pressure 23 per cent. greater than the counterbalanced machine.

The determination of valve and pumping plant units is identical with the unbalanced elevator and will not be repeated.

Estimate of Cost

The cost of such an elevator, including patterns, should not exceed the following:

Sinking cylinder	$120.00
Car	60.00
Plunger	50.00
Plunger top and bottom	7.50
Plunger nipple	5.00
Cylinder	45.00
Sinking head	10.00
Cylinder head and stuffing box	14.00
Sinking apparatus	20.00
Valve	25.00
Control ropes	6.00
Counterweight ropes	36.00
Control sheaves	4.00
Counterweight sheaves and boxes	25.00
Counterweight beams (long leaf pine)	7.00
Piping	50.00
Tanks	150.00
Counterweight	35.00
Guide rails	3.00
Counterweight guide rails	2.50
Guide rail supports	10.00
Erection	200.00
Miscellaneous	50.00
Rope hitches	15.00
Total	$950.00

To the above should be added cost of pump.

In closing I want to emphasize the fact that the cost of replacements are practically nil and that maintenance should not exceed $5 per year.

Reinforced concrete continues on its conquest, as in a report submitted at the convention of the International Union of Street and Interurban Railways, held in Munich a few months ago, it is noted that several German street-railway lines have been using reinforced concrete cross-ties upward of four years, and the results have been entirely satisfactory. The ties are 7.2 feet long, weigh 308 pounds, and cost about $1.50 each. The concrete is composed of 33 per cent. cement and 66 per cent. gravel, and the reinforcement consists of five round bars ⅝ inch thick. Their great weight lends stability, the rail fastenings are very secure, and there is but little wear caused. They promise to have a much longer life than wooden ties, and are considered by a great many to possess advantages over the much looked to metal tie.

A Lathe Converted Into a Cylinder Grinder

By M. E. Dawson

In the past much attention has been given by builders of machinery and also by automobile makers to the internal grinding of auto-engine cylinders. While there are now a number of special grinders for this purpose on the market, yet some foremen, who are in charge of this department where automobiles are made, prefer to design and build grinding machines wherein they can put into the construction details which help to turn out cylinders as near perfection as is required without doing the grinding "to death."

In the accompanying line cuts is shown an engine lathe converted into a grinder for automatically grinding automobile-engine cylinders. Very often an old lathe which has seen its best days is converted into a special grinder without any regard for strength or stiffness. This may be all right for certain kinds of grinding, but for auto-engine cylinders it is a mistake.

The lathe for this cylinder is 26-inch swing and of heavy construction with an extra large hollow spindle and large bearings capable of taking care of the overhanging weight of chuck and cylinder while revolving in the process of grinding. Fig. 1 is a front elevation of the lathe, chuck, and automatic attachments assembled. The chuck is correctly shown in the front elevation, Fig. 2. After a number of experiments this design has proved the most satisfactory.

A face plate, an outer head and three staves all in one casting constitute the chuck. The staves are equally spaced, and the openings are large enough to admit a cylinder between them. The outer head is machined and bored to receive the turned end of the cylinder; holes are also drilled for the clamping bolts. The openings between the staves must be greater than the length of the cylinder over all so as to admit the cylinder. After the cylinder is clamped in position a piece of stiff rubber hose is placed between the cylinder and the face plate, closing the space between the face plate and the cylinder end and making a continuous pipe-like connection from the cylinder through the spindle and pulley sleeve, through which opening the dust created by the grinding is exhausted.

To the spindle at the back end a cast-iron sleeve is connected, machined to form the driving pulleys. In the hole in this sleeve is inserted one end of a 90-degree pipe bend, and to the other end of this elbow is attached a piece of hose which is connected with a dust-collector pipe; this shows how the dust is taken care of.

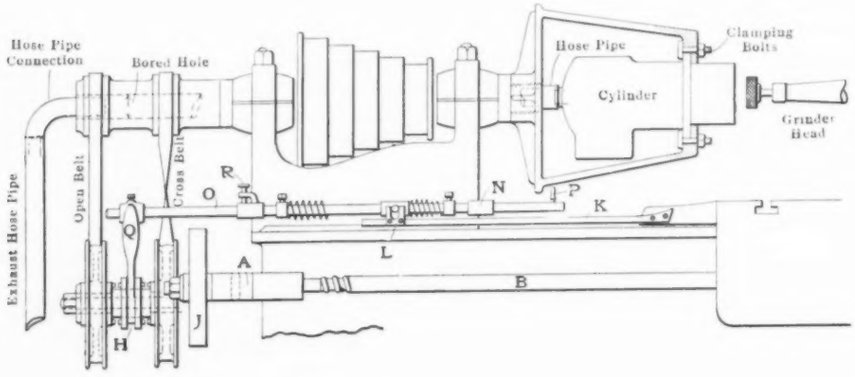


FIG. 1. THE LATHE CONVERTED INTO A CYLINDER GRINDER

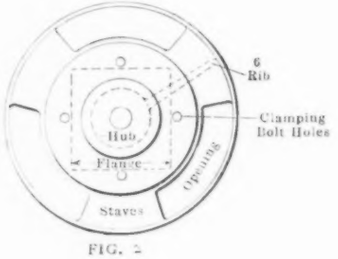


FIG. 2

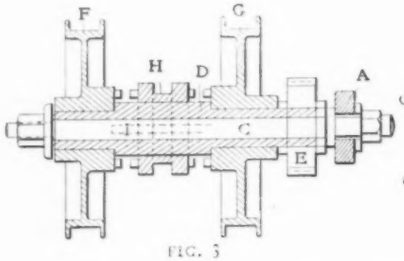


FIG. 3

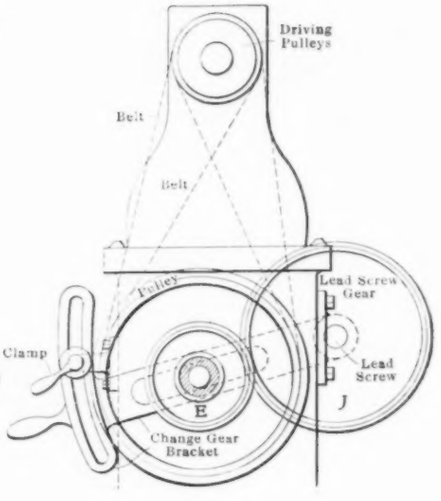


FIG. 4

THE CHUCK AND THE DRIVING GEAR

The automatic shifting device is shown in Figs. 1, 3 and 4, and consists of a change-gear bracket *A* loosely mounted on the lead screw *B*. To this bracket is secured a stud shaft *C* on which revolves a sleeve *D*, to which is secured at one end a pinion gear *E*. On the sleeve *D* are two loose pulleys *F* and *G*, and between these pulleys is a clutch *H*, which is free to slide on a key and feather *I*; it has inserted clutch pins which engage with corresponding pins in the inside faces of the pulley hubs. The pinion gear *E* engages with a gear *J* secured to the end of the lead screw at the front of the lathe; this is shown in the end elevation, Fig. 4.

The original design of this lathe answered the requirements to make a good grinder as well as if specially designed for one. No change was made in the lead screw, lead-screw gear, or change-gear bracket; in fact, the latter can be set so as to give ample distance between belt-pulley centers, also providing for taking up belt slackness in an instant, which is not the case in a number of specially designed grinders.

The shifting device is shown at the front of the lathe head. The angle iron *H* is split in the center at one end and bolted to the carriage. At the other end is a flat piece of machine steel *E* with a U-shaped slot. Secured to the lathe head are two brackets *M* and *N*, which carry the clutch-shifting rod *O*. At one end is a handle *P* to provide for shifting by hand when necessary. At the other end is an arm *Q* engaging with the sliding clutch. Between *M* and *N* are two collars and two springs, and loosely mounted on the rod between these springs is a hub with a projecting pin which engages in the slotted piece *L* on the angle iron. The traverse of the carriage can be regulated by adjusting the collars on the shifting rod.

The grinder head is secured to the tool-post holder on the carriage. The grinding starts when the carriage moves ahead. The angle iron which is bolted to the carriage moves the pin hub on the shifter rod until it meets and compresses the spring sufficiently to suddenly release the sliding

clutch from one and instantly engage with the other, which causes the carriage through the medium of the gears and lead screw to travel backward or forward.

If desired the special attachments can be removed in a short time and the lathe converted back to its original design, or the feed clutch disengaged and secured by the locking pin *K* in the clutch-shifter rod. The lathe spindle runs 110 revolutions per minute without jar or vibration, which fact proves that the revolving parts are correctly and accurately balanced, which is a big factor in the production of A-1 cylinders.

Universal Cam Cutting Machine

The cutting of accurate cams enters so largely into some classes of automatic machinery that the Kearney & Trecker Company, Milwaukee, Wis., has designed and built a special cam-milling machine which is universal in that it can handle either face or periphery cams with equal accuracy and facility. Figs. 1, 2 and 4 show different views of the machine in half-tone while Fig. 3 gives the constructive details of the machine.

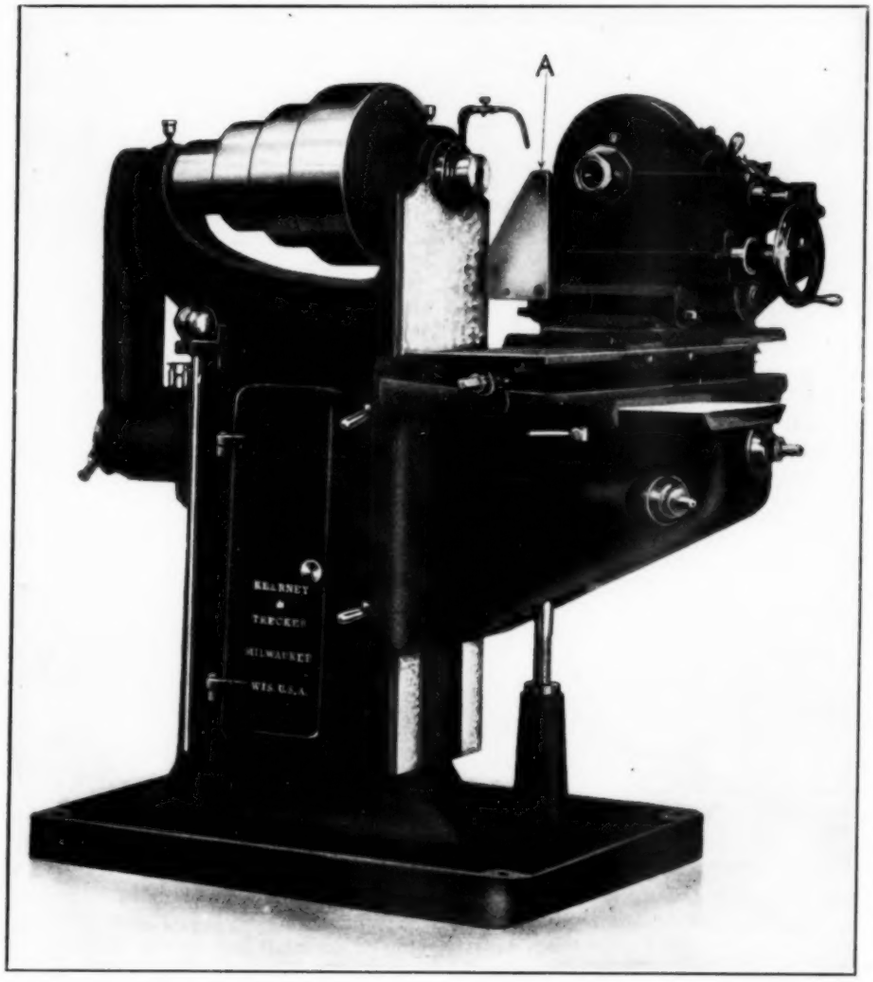


FIG. 1. FRONT OF UNIVERSAL CAM MILLING MACHINE

Details of Construction

This machine consists of a frame or column very similar to that used on a horizontal, knee-type milling machine, the over-arm being omitted and is shown in detail in Fig. 3. Mounted on the knee, which is a box section without a hole through the top so as to make it strong and rigid, is a saddle having in and out adjustment. This carries a second saddle, 2, mounted upon it, having adjustment crosswise of the knee and at right angles to the spindle, very much as the work table of a milling machine would have. This saddle carries a swivel carriage, 3, which can be set at any angle for milling either face or periphery cams.

Sliding on this saddle is a head 4, carrying the work spindle 5, and its driving mechanism. This work spindle can have its front end constructed to meet the requirements likely to arise in the particular factory where it is installed. Fig. 1 shows this spindle having a different construction, viz., taper hole arranged to receive arbors, these arbors being made with slots to fit the key milled on the spindle itself at the outer edge so as to insure correct alinement of the cam being milled upon and the master cam.

For milling face cams the work table is adjusted to a position shown in Fig. 2 and also in Fig. 3. Both the master cam and the cam to be milled are placed on the front end of this spindle, the master cam engaging with the roller on the pin *A*, Fig. 1, the plate carrying this pin being fastened to the swivel carriage 3. It will readily be seen that where the master cam is a closed leader, that the work spindle will move in unison with it and the shape will be reproduced, either the same size or larger or smaller as desired.

The work spindle is revolved by means of a worm-wheel 6, which is keyed to the sleeve 7, the spindle 5 being free to slide endwise through this sleeve or revolve in it. The disk 8 is keyed to this sleeve and the pin 9 forms a driver for it. In milling face cams, no end movement is necessary. It is consequently located as to end movement by the split collar and driver 10, and the clamp collar 11.

Periphery Cams

In milling periphery cams the work spindle is moved to a position as shown by Figs. 1 and 4. In this case the leader pin *A* is not used. The master cam is now placed on the rear end of the spindle between the set collar and the shoulder on the large part. The leader pin is attached to the frame on the back side of the head, but is invisible in the illustrations. The driver 10 is adjusted away from the end of the sleeve 7 and as it is free to slide on the driving pin 9, the spindle will be moved back and forth endwise by the master cam and its leader pin and roller as the spindle revolves. The drive plate 8 has a T slot arranged to trip the feed at any predetermined point as in the case of only partial circles or where it is desired that the feed should not go beyond one revolution. The trip block *B* is brought into play for this purpose, the lever *C* being used to trip the feed by hand. Both the lever and the trip block operate through a fork on the clutch 12, disengaging the worm shaft 13. To return the spindle by hand, it will be noted that both a slow and a quick movement are provided, the hand wheel 14 being shown on the worm shaft. It can, however, be moved to the shaft 15, and engaged with the clutch 16 on that shaft when a rapid movement is obtained through spur gearing. The gear 17 is not shown as directly engaging with the pinion on the worm shaft; because it engages with the idler 18, so as to have the hand wheel turn in the same direction for both slow and quick movements.

The drive down through the center of the saddle 2 and the means provided for the movement on the head on 3 are too clear to need explanation. The gear 19 is a spiral gear engaging with the spiral gear 20. These are driven through three spur gears located at the back of these gears. 21 is directly connected with a universal joint and is carried in the saddle

by an eccentric bushing having two different locations. One of these locations brings this gear into engagement with the gear 22 directly on the spiral gear shaft. The other location brings it into engagement with 23 and causes a reverse motion in the feed. Reverse to the feed is quite essential on milling where the cutter cuts on one side only and may, in some cases, be internal and in others external. This makes it possible to mill with the cutter against the cut in either case.

Provisions for Different Kinds of Work

To provide for experimental work or milling with open leaders, the bracket 24 is provided, carrying a grooved pulley over which a flexible cable may pass carrying a weight to keep the leader pin in close contact with the open leader. The upper position of this roller is for the purpose of making the same connection with the end of the spindle through the swiveled bolt 25.

Ample provisions are made for the milling of steel or other materials requiring lubrication in cutting by ample oil channels cast in the saddle 1. In addition to this a shield, shown in Fig. 2, is supplied to turn the oil into these channels, the reservoir from which the oil is pumped being located in the base of the machine. The telescopic piping 26 is provided to return the lubricant to the reservoir, it first passing through a screen to remove the chips. The pump is driven by a round belt, passing over the pulley on the inner end of the shaft 27.

The feed is provided with 12 changes, giving an ample range for cams of any size within the range of the machine. The feed box is the standard type, used on the milling machines made by this company and is driven through a train of spur gears, as shown. Cams up to about 2 feet in diameter can be milled on this machine.

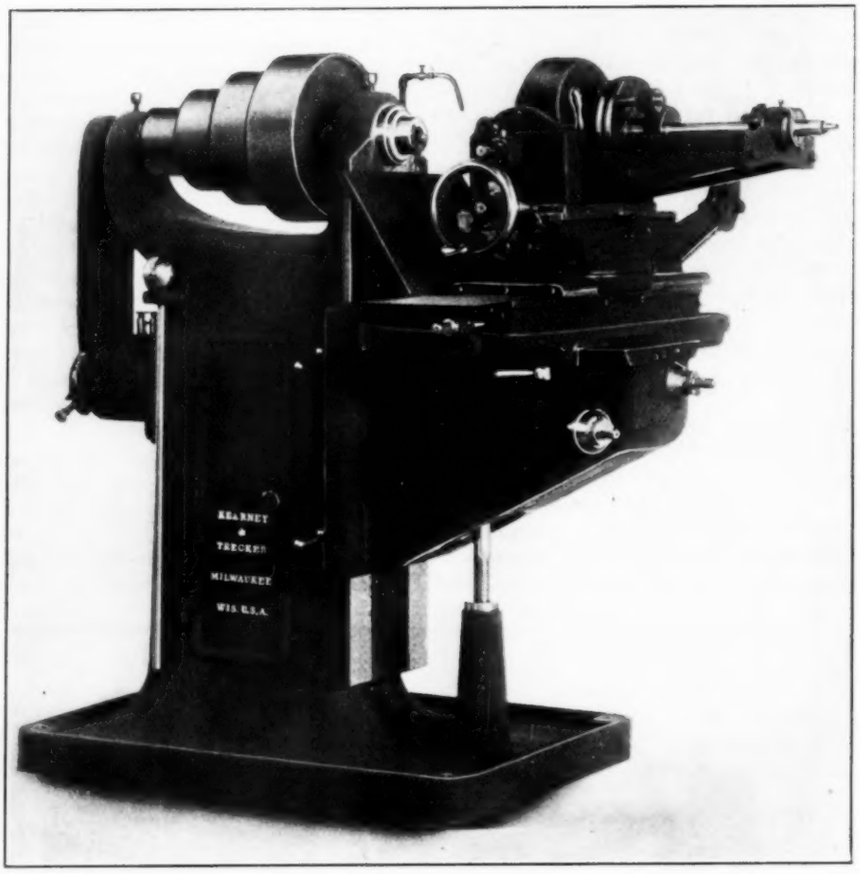


FIG. 2. ARRANGED FOR MILLING FACE CAMS

It is estimated from a reliable line of investigation that the annual damage done by natural floods in the United States amounts to not less than $100,000,000, a figure hardly believable.

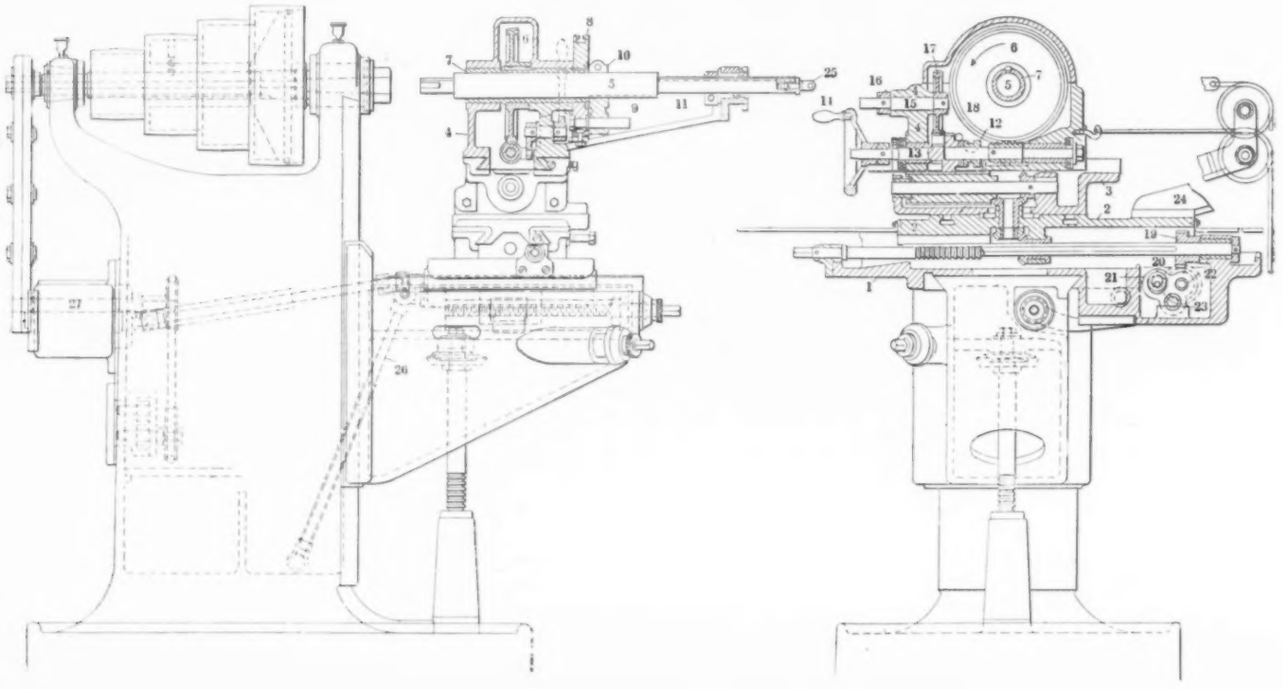


FIG. 3. DETAILS OF A SPECIAL CAM CUTTER

Organization and Management of Trade Schools*

The Experience of the Williamson Free School of Trades in Developing Journeymen Mechanics, the Instruction Being by Exercise Work Only

BY JOHN M. SHRIGLEY†

I am to speak to you today on the organization and management of trade schools. It is a pleasant subject, because as a rule, the young men who are being trained in a properly conducted school of that type take great interest in their work, and are so enthusiastically devoted to it that their progress is wonderfully rapid and gratifying.

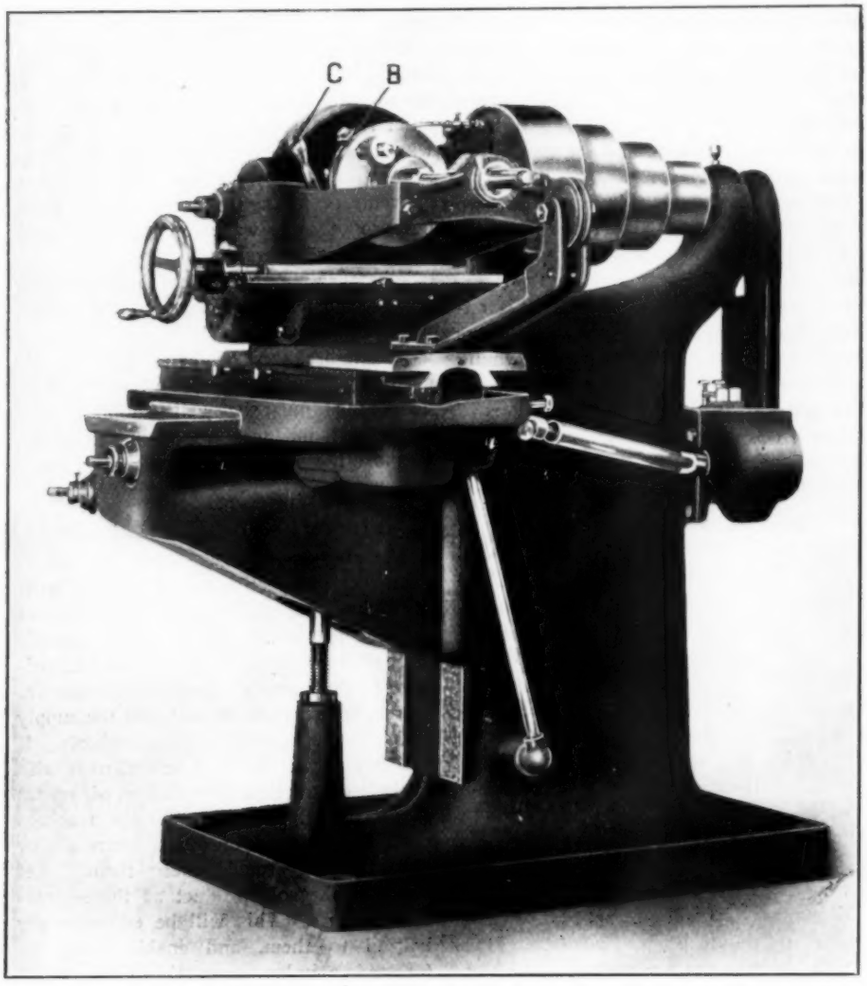


FIG. 4. THE OTHER SIDE OF THE MACHINE

Time will permit me to refer to only a few of the most important details involved in the foundation and administration of such schools.

Boys generally are insufficiently developed mentally and physically to enter vigorously on trade work with the tools and appliances used by journeymen before the age of 16 years, 17 being probably better still, while 18 is not undesirable.

If a school proposes to graduate journeymen (and my article is based on that supposition) the pupils must be sufficiently matured physically and mentally on graduation to do men's work. They must have the appearance as well as the qualities of manhood to merit a man's pay. No matter what plan may be adopted for teaching trades this is a most important consideration, and must not be overlooked.

I will not enter on the question of earlier preparatory training for such schools as I have in mind, but undoubtedly such preparation is to be commended.

The most difficult question in this whole matter is that of securing qualified pupils of the proper age, and retaining them in schools until the close of their apprenticeship. In the school with which I am connected this difficulty has been eliminated by some favorable conditions. The continuous interest of the pupils in well graded instructional exercises is so great, however, that very little disposition is manifested to withdraw from the school before the completion of the full course.

Candidates should be examined physically and academically, and their general fitness and desirability ascertained from references, and by personal interviews, and no one should be accepted as a pupil who has not a positive intention of beginning his business career as a workman at the trade which the school will teach him. That this is practicable is shown by the fact that as high as 98 per cent. of the members of a class of our school have, on graduation, immediately started as journeymen at the trades taught them.

Selecting the Trade

Young men sometimes have a fancy for vocations for which they are mentally and physically unfitted, and an important duty of those in charge of trade schools is to decide what trades are best for applicants, and, if necessary, endeavor to convince them of the soundness of their decisions. Failing in this the candidates should not be accepted, as it is generally unwise to undertake to train young men for trades which they dislike, and just as wrong to put them to one for which they are unqualified. As a rule, however, very few fail in trades for which they have a fondness, but if after a moderate trial any should be found unfitted for their vocations, they should be dropped from the roll.

Generally the average boy can succeed at any one of several trades. A long experience in the matter indicates that the trade should be fixed at the beginning of the school course, otherwise valuable time is lost in experimenting, and uncertainty and disagreement on the subject are quite likely to follow.

The courses must be of sufficient length to include well graded and thorough instruction in the practice, as well as the theory of trade work, with proper collateral academic training, especially in mathematics and mechanical drawing. As one mechanical process is mastered it should at once be succeeded by another. This advancement, and the knowledge that the sole object of the instruction is to benefit the pupils, adds greatly to their interest in their work.

*An address before the Atlanta meeting of the National Society for the Promotion of Industrial Education.

†President, the Williamson Free School of Mechanical Trades.

Time must be given to enable the pupils to properly absorb or assimilate what is taught them, and in most trades three years is not too long for this purpose. A certain moderate time should be devoted to culture studies such as physics, elementary chemistry, civil government, literature, etc. A man may be a carpenter and murder the King's English, and a physician may give you medical advice without being familiar with the history of his country, but both would be better equipped for life's services and enjoyments with the wider training.

The larger mental culture will give increased general intelligence to our young mechanics, making them better workmen and enhancing their prosperity.

We should do whatever will help their progress and development in the line of their work and add to their happiness, and it is, therefore, our duty to deal liberally with them in their training, bearing always in mind the importance of good citizenship as well as mechanical efficiency.

Some may think that giving a young mechanic a fair general education will lead him away from his vocation. Similarly some years ago prominent manufacturers feared that any training in trade schools would largely result in spoiling the boys, or as one expressed it: "They will be unwilling to work with their shirt collars off." If either of these untoward effects should follow, it will be the fault of the *school management*, and not the system.

When the mind and hands are working in unison the interest in labor does not diminish, but it increases.

Professor Davenport, dean of the College of Agriculture, University of Illinois, well expresses the thought I have in mind, when he says: "There is no higher duty resting upon all of us than to see to it that no individual shall be compelled to choose between an education without a vocation, and a vocation without an education—I would have it so that the occupation of an American citizen may not be known by his dress, his manner, his speech, or his prejudices."

A University Graduate as a Bricklayer

In illustration of this phase of the subject allow me to repeat the following anecdote:

Some years ago Dr. D. Hayes Agnew, the eminent surgeon, while waiting in the parlor of a Philadelphia residence for another physician, noticing how substantial and attractive the house was, said to the owner: "You have a delightful and well built home," to which the gentleman replied, "I am glad you are pleased with it especially as I built it myself." He further explained that his father was a bricklayer who had two sons, and feeling that his life had been somewhat hampered by lack of early educational advantages, he determined to give his boys a college training. The elder finished his course at Princeton with credit and became a lawyer. The younger (the owner of the house) also had an honorable career at the same university, and when he returned home after graduation his father said, "My son, I have made it possible for you to obtain an excellent education, but that is all I can give you, and you must now decide what occupation to follow." The reply was, "Father, let me have two days to think the matter over." At the end of the time he said, "Father, bricklaying sent me to Princeton and I will be a bricklayer." Continuing, he remarked, "I began at the foot of the ladder as an apprentice, finished my time, became a journeyman, then a foreman, and afterward a contractor. I built this home and other houses, and now my rents from the latter have made me independent financially, and I can work or not as I please." Doctor Agnew said that this interview with a cultured gentleman engaged in an occupation, which before had seemed to him common, vastly increased his appreciation of the dignity of labor.

Returning to the trade exercises, we must insist that they be very comprehensive, qualifying the apprentices to readily cope with the practices and problems involved in commercial work. This is entirely practicable, and it is pleasing to note the comparative ease with which young men thus trained can apply their knowledge and skill to the varying conditions of the business world. The mechanical drawing after the elementary exercises must directly pertain to the specific trades.

Shop Instruction Dominant

Throughout the entire course the leading feature of the training must be the mechanical, while the academic instruction, especially in mathematics and drawing, must have a well defined connection with trade work. I repeat, the dominant tone of the school must be the shop instruction, the academic being auxiliary to it. Trades can be taught best in schools especially devoted to that work, rather than in those in which they are merely adjuncts to general education.

Pupils must be taught to work speedily, but never at the expense of accuracy, which must always be insisted on, and time cards should be used whenever practicable, as they are an incentive to industrious application. Speed exercises are of advantage especially in the closing year. The value of materials must be constantly kept before them, so that they may be economical in their use, and estimating costs should be a part of the instruction.

The earlier and simpler trade exercises must be combined in more complex problems toward the end of the course. The school day should be eight hours long on five days of the week, and about three hours on Saturday, divided equally for a while between trade and academic studies. During the last six months of the apprenticeship the whole day should be spent on mechanical exercises. This adds to the ease of the transition to commercial fields. There is no difficulty in maintaining satisfactory continuing interest during days of the length indicated.

There seems to be no limitation as to what trades can be taught in schools, even chimney sweeping being included in the German curriculum.

As it is easier for graduates to obtain employment nearer home than at a distance, the trades embraced in a school's course must be governed to some extent by its environment, though some are of such a general nature, as carpentering, plumbing, etc., that they may be taught almost everywhere. American trade-school graduates have already found profitable employment in foreign countries.

It is of great importance that employers should not induce school apprentices to abandon their course before graduation, to enter on commercial work. Those of us who have had experience with the shop system know how it has suffered from apprentices failing to complete the time because of some wage temptation offered by other employers.

Whatever may be our opinion of strikes it follows as a matter of course that under no circumstances should schools be used as strike-breakers. When trade schools become general there will be fewer strikes. The shops must be well equipped with tools and appliances embodying the types of those the pupils will handle after graduation.

The Importance of Capable Teachers

The mechanical teachers must be masters of their respective trades, of good general education, well versed in mechanical drawing and mathematics, and be capable of readily imparting their skill and knowledge to their pupils. Such instructors are scarce, but they can be had, and the supply will increase as trade schools multiply. It will not answer to have school men with a limited practical knowledge of trades as mechanical teachers. Trade teachers should never work on pupils' exercises, or put finishing touches on them. Let them be the sole product of the apprentices' efforts. This will be educationally helpful to them, and enable those interested to judge accurately of the results of the school's efforts.

Teachers should have opportunities from time to time to visit leading outside shops, and by study of books and papers pertaining to their trades, keep abreast of the times.

Each trade should have its own expert teacher, and no teacher should have charge of more than one trade. Mechanical teachers should have good salaries. Some rate their value too low.

It is very desirable to have on the managing boards of trade schools representatives of mechanical avocations. Such schools should stick close to their object, viz.: "to train journeymen mechanics,"

and not be led by ambition to stray into other fields. They must constantly impress on their pupils that the purpose of their training is to fit them for work as journeymen, and that they must not expect on graduation to be employed at once as foremen, superintendents, etc., though these positions may come to some of them later.

Work Should Not be Made for Sale

It naturally follows from what has been stated that all trade-school work should be instructional, and that nothing should be made for sale. That would make it necessary to keep the pupils at processes with which they are quite familiar, otherwise the products would be unsalable. To manufacture for the market would not be scholastic, neither should schools be run as competitors of legitimate business enterprises, or paid labor.

Employers are sometimes unfair to trade-school graduates. Let me illustrate this by one example: Some years ago two young men graduated from a trade school as patternmakers. One, the more intelligent and skilful of the two, unwisely applied to a concern which does not believe in the school plan. He was asked where he had worked, and replied that he was a trade-school graduate, and was then told that he could not be given more than $8 per week for a beginning, and would be expected to work for two years before receiving full wages. Foolishly he agreed to this. The second one obtained work in a jobbing pattern shop for $12 per week, and after being there about six weeks applied for work at the manufactory where No. 1 was employed, giving the address of the place where he had been, but making no reference to his apprenticeship. He was told to come to work and his wages would be fixed at the end of the first week, when he would be paid in accordance with his worth. When he received his pay envelop he found he was rated at $18 per week, over twice as much as his brighter classmate was receiving in the same room and on the same work. Fortunately, nowadays such employers are becoming exceptional, most of them placing high value on trade-school graduates.

Graduates from all vocational schools, be they trade schools, technological institutes, normal schools, colleges or universities, will continue to learn after they have finished their course at their Alma Mater. Some of us who have been in the harness many years are still adding to our store of knowledge and efficiency.

It is claimed by some that graduates in professional lines are not teachers, physicians, lawyers, engineers, architects, etc., when their prescribed instructional courses are completed in good institutions of learning, nevertheless no educator would recommend the abandonment of the methods used in them. The ease with which practice and theory can be combined in trade schools makes it less difficult to teach trades in such schools than some professions in colleges. I submitted the question to a prominent dentist, a graduate of the dental department of the University of Pennsylvania, by asking him what became of young men or women who had been trained for dentistry in a reputable college. He answered, "They practice their profession." I said, "You consider them dentists?" He answered, "Of course, I do." I asked him if it were not necessary to spend a considerable time in the office of an established practitioner before entering on professional work, and he said, "Undoubtedly no." I mention this profession particularly because it is so largely dependent on mechanical skill for excellence.

It would be foolish to claim that a school graduate with a good theoretical, but little practical knowledge of his trade, graduates as a journeyman, and I will again urge the importance of having sufficient trade practice in schools. With a course of ample length this practice can be given with wonderful efficiency, provided the exercises are sufficiently wide in scope and in thoroughness.

Graduates in Demand

It is not my province to exploit the school with which I am connected, but I must mention it so that you may see that there is a solid basis for my opinions. In periods of normal business it cannot begin to meet the demand for its graduates as journeymen at fair wages. They are regularly employed as such by manufacturers and contractors, who have not the slightest special interest in our enterprise, but they are hired simply because they make very desirable and profitable employees, and let me add they rapidly become the highest grade journeymen in the shops in which they work.

Take the trade of bricklaying, one which specially requires great dexterity and endurance, and frequently our graduates in it obtain the highest wages during their first season. This would be simply impossible if they left us otherwise than journeymen.

After an experience of nearly 21 years as a manufacturer with hundreds of apprentices in the trades of blacksmithing, patternmaking, molding and machine work, and an added knowledge of twenty years' trade-school work with nearly 1200 pupils and almost 700 graduates in the trades of bricklaying, carpentering, machine work, patternmaking and stationary engineering, I unqualifiedly assert that trades can be satisfactorily taught in schools. With us at Williamson this is not an inference or a theory, but a well demonstrated fact. The truth of the matter is, that there is no mystery in teaching trades in schools, and when the subject is approached in a mechanical and business-like manner, and handled in a simple rational way, satisfactory results are sure to follow. Those of us who have labored sympathetically and earnestly in this direction know that it is not difficult to train in schools young men to be thinking mechanics with fine practical skill. This is corroborated by the experience of some of the best trade schools of Belgium and Holland.

President Eliot, of Harvard, writing on this subject says, "The apprentice system has been in past centuries, and still is to some extent, an unjust and imperfect method. It is a slow and wasteful way of learning a trade and liable to great abuses. Any bright and diligent youth can learn a deal more in three years at a good trade school than in seven years of apprenticeship."

German and American Trade Schools Compared

In comparing the quality of the work being done in foreign trade schools with that of the American schools there is a tendency to underrate the latter. In that connection it seems to me advisable to give the opinion of Prof. Omer Buyse, an intelligent leader in vocational training in Belgium. In a comprehensive work just published on the methods of American mechanical schools, based on his personal inspection of many of them, he says, that "The Williamson School eclipses all similar institutions in Europe."

I would further remark on this phase of our subject, that it was my privilege last summer to visit some European trade or vocational schools, and I make bold to say that the results being achieved there, particularly in Germany, are not so much because of the specially high grade of instruction in mechanical lines, but because they are doing something, and probably the best that circumstances will permit. Furthermore, there is unity of sentiment and action; the government, the schools, the manufacturers, and the trade unions or guilds being in full accord. I think the tendency there is to throw an increased share of the responsibility on the schools, rather than on the shops. Indeed, Dr. George Kerschensteiner, in charge of the Munich mechanical schools, who is thought to be the leading German authority in such matters, said to me, "A shop or factory cannot produce a good mechanic. Nearly all of them lack sufficient variety in scope or range, and quality of work to enable them to do so. Furthermore, many of them are not prepared to impart to their apprentices what they know themselves." Of course, in making this statement he only referred to conditions in his own country.

It was my good fortune to see at the Munich Exposition a very large and interesting exhibit of the product of the mechanical schools of that city, which embrace numerous trades. It was altogether on instructional lines, no article for sale being made in the Munich schools.

The Franco-British Exposition has a fine exhibit of the work of the French

mechanical schools, showing especially the progressive instructional exercises used in the machine trade. Instruction seems to be the basic principle of both the French and German trade schools.

When parents and employers generally learn the splendid possibilities of trade training in thoroughly organized and carefully administered trade schools, there will arise a great demand from them for such institutions. Such schools will so dignify handicrafts that the fathers and the mothers of the future will consider them of a class with the colleges and technical schools when deciding what training to give their children. They will realize that as fine opportunities are open for skilful mechanics as for those trained in the professions.

There are other ways to teach trades than the one outlined in this article, such as the regular shop-apprenticeship system, the same system with academic instruction in connection with the shop, or with academic instruction in outside schools, or academic instruction in schools with mechanical work in manufactories. Our main reliance for trade instruction in the United States must be upon our public-school system.

Social and financial conditions are such that for the present all must have a share in the good work, and there should be no contention between the advocates of the various plans. It is important in this connection that our society should not underrate trade instructions wherever given, and let us urge that it be thorough, however imparted. There may not be entire agreement in methods, but I think that we are in accord in our ideals.

Some trades under existing conditions may, for the present at least, require different treatment from others, but for the trades with which I am familiar, I believe the one advocated in this paper to be the best. The thoroughness of our work is shown in various ways. Take, for instance, the machine trade. Our graduates in that department are efficiently employed in building locomotives, cars, typesetting machines, stationary engines, automobiles, machine tools, dynamos, motors, general electric machinery and appliances, steam pumps, gas engines, elevators, etc., and are also to be found in shipyards, steel works, railroad shops, etc.

Results of Trade-school Work

Hundreds of instances could be given of the fine results of training such as I have outlined, but I will mention only one. In a letter just received from a bricklaying graduate of this year's class, who is earning $5 per day and is a member of the union, he writes: "I wish to express my sincere gratitude for the kind and logical instruction which I received at the Williamson School. My graduation is a matter of great satisfaction to me, as I am confident the instruction I received there, enables me to hold the position I have had during the past few months. Many times I thought the lessons assigned were hard and difficult, but now I realize they were only stepping stones to a higher, better and broader plane in this business world of ours." I have given this extract to show the appreciation of broad and generous training by one who has experienced its beneficial effects in his trade work.

Dr. Channing, in an address delivered before a mechanics' institute, in 1838, expresses the thought I have been endeavoring to convey in another form. He says: "I have now given a few views on the culture, the improvement, which every man should propose to himself. I have all along gone on the principle that a man has within him capacities of growth which deserve and will reward intense, unrelaxing toil. I do not look on a human being as a machine, made to be kept in action by a foreign force, to accomplish an unvarying succession of motions, to do a fixed amount of work, and then to fall to pieces at death, but as a being of free spiritual powers; and I place little value on any culture but that which aims to bring out these, and to give them perpetual impulse and expansion.

"I am aware that this view is far from being universal. The common notion has been that the mass of the people need no other culture than is necessary to fit them for their various trades; and, though this error is passing away, it is far from being exploded. But the ground of a man's culture lies in his nature, not in his calling. His powers are to be unfolded on account of their inherent dignity, not their outward direction. He is to be educated because he is a man, not because he is to make shoes, nails, or pins. A trade is plainly not the great end of his being, for his mind cannot be shut up in it; his force of thought cannot be exhausted on it. He has faculties to which it gives no action, and deep wants it cannot answer."

In conclusion I would say we must not only prepare trade-school graduates by their knowledge, skill and efficiency to earn a comfortable living and a surplus, but teach them to so live physiologically, mentally, morally and spiritually, that they will have sound minds in sound bodies, and be capable of rendering their fair share of services in all the higher activities of life, a blessing not only to themselves, but to their fellow creatures.

The Roosevelt dam now being built by the United States Reclamation Service, on Salt river, Ariz., when completed, will be far the largest artificial lake in the world. It will impound 1,300,000 acre-feet of water, and will thus hold the record until the completion of the Engle dam. At present an Indian reservoir, which is filled only once in about 20 years, is the largest, with a capacity of 950,000 acre-feet.

Surrounding the Main Air Pipe with a Steam Coil to Prevent Freezing

By J. J. Newbaker

We have in use a number of pneumatic tools used for chipping out the seams in steel blooms in order to produce perfect material for the manufacture of seamless tubing. The building in which the work is done is located some distance from the air compressor and the main air pipe between the two buildings is exposed to the cold weather. To heat the air to prevent freezing it has been customary to surround a section of the air pipe with several steam pipes placed longitudinally therewith. Following out a desire to improve on this method I surrounded the pipe with a spiral coil.

Our machine department declined to undertake the winding of this coil cold on the plea that it was not practical and advised that the work be ordered from a pipe-bending shop. As this would mean considerable delay and extra expense I determined to do the job myself, which I did with entire success as follows: Not having a lathe at hand I used a pipe-threading machine instead. For a mandrel I used a 4-inch pipe 20 feet long, one end of which was held in the chuck of the machine, and the other extending to the rear supported by a forked floor stand. A hole was drilled through the pipe near the machine at a right angle to its axis and the first section of pipe to be coiled, ½ inch outside diameter, was secured to the mandrel by means of an eye bolt passing through this hole and held securely in place by a nut on the opposite end. The pipe extended through the eye bolt 6 or 7 inches and remained straight that far for convenience in connecting to the main steam line. With one helper controlling the machine, another holding a piece of 2x½-inch flat iron on top of the pipe mandrel to gage the pitch of the coil and two holding back on the pipe to be coiled the machine was started. When the end of the first section of the coil approached within a foot of the mandrel the machine was stopped and another length of pipe attached by means of an ordinary coupling arranged to butt the two pipes squarely in the center and forced solidly together. As the coupling approached the mandrel I heated it on each side with a pneumatic torch to prevent overstrain on the joint after which the winding proceeded cold as before until the point arrived to attach another section.

This operation was repeated until sufficient coil had been produced for my purpose. The length of the spiral pipe when finished was 13 feet, with a 2¼-inch pitch except 16 inches on the last end, which was wound close. The finished coil was

perfectly tight under 200 pounds gage pressure. After it was in position on the air line and heated up with steam it was covered first with heavy asbestos paper and finished with plastic pipe covering.

Echoes from the Oil Country—Some of the First Steps in Micrography

By W. Osborne

The numerous photomicrographs of the various metals which have been appearing in the trade journals for some time back have been very interesting. It would seem that they have a wonderful story to tell and the question very naturally comes up as to whether the microscope can be made a shop tool, or if not a shop tool, at least a tool to be used in the tool room or the shop laboratory.

Judging from the revelations which it has made to the scientific man the possibilities seem almost boundless, yet an instrument in the hands of a scientific man and the same instrument in the hands of a mechanic may act so widely different that it could not be recognized by the results.

Having access to a good microscope and some literature on the subject being at hand, I have tried to find out what I could see and interpret.

The first thing that the microscope told me was that I did not know how to get up a surface free from scratches. Being a machinist, and steel being the most convenient metal at hand and the one the books told the most about, I tried my skill on various pieces picked up from the blacksmith's scrap pile. They were picked up without any regard to, or knowledge of, the carbon. Before very long it was discovered that there was much difference in the way these pieces behaved while being polished. With some of them it was comparatively easy to get a nice looking surface, while with others it was very difficult to do it, and the appearance of the surfaces would show quite a variation even to the unaided eye. When an effort was made to etch the pieces it was found that some of them got very black with the shortest immersion, while others resisted a relatively long one.

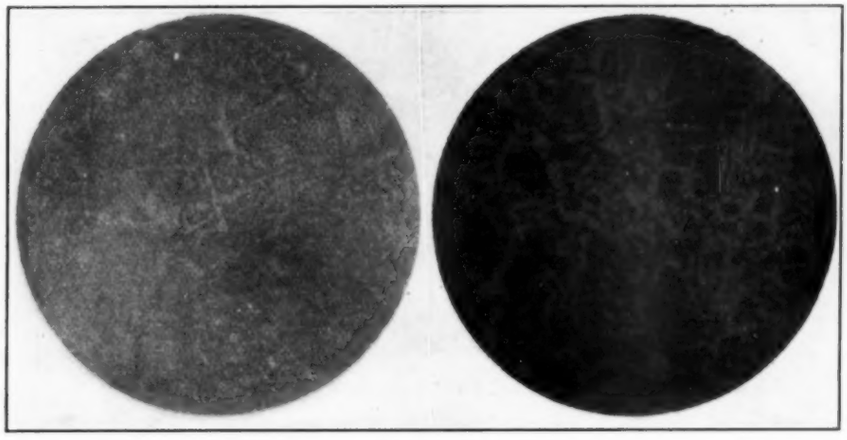


FIG. 1 THE FIRST PHOTOMICROGRAPHS FIG. 2

Examining them under the microscope revealed very widely different configurations, but none of them looked like the pictures which I had seen.

After spending a lot of time polishing and etching and looking, the question came up as to how much of the difference in appearance came from the difference in etching and how much came from the difference in the material. If the same piece of material could be given a multitude of appearances by manipulating the etching perhaps some of these appearances might look so near like the appearance of other pieces of different composition that confusion would result. And just here I would say that I found that it was not an easy matter for me to examine a piece and then carry that picture in my mind while I repolished the piece to a new surface and re-etched that surface. I can always see the piece that is before my eyes much plainer that I can see the one that is in my mind. It seemed reasonable to try to get the camera to hold fast the sight which the microscope revealed and I tried it.

Trying to answer the question as to whether more or less etching changed the characteristic appearance of a specimen, I started with a specimen which is supposed to contain about 0.35 per cent. of carbon. An examination, before etching, with a medium powered lens, disclosed some spots and numerous scratches which my art of polishing had not been able to remove. With a very diluted acid for the bath the piece was given an immersion of about two seconds. This did not dull the luster and the immersion was repeated, with the result that some faint lines appeared as seen in the half-tone, Fig. 1. The microscope still showed numbers of the scratches, but the camera is merciful enough to conceal most of them.

A further etching brought out more marks, as seen in Fig. 3, and still more brought out the appearance seen in Fig. 2. The process showed up very much like developing a plate in photography. First came the high lights and gradually the details began to appear. Some of my first efforts at developing the specimens had resulted in overdevelopment. After that I did some underdevelopment.

Besides the difference of appearance which comes from the difference in the etching is the difference which comes from the power used in the magnifying. In Fig. 4 the low-power lens was used. In Fig. 5 the medium-power lens was used, and in Fig. 6 the high-power lens was used. An examination of Fig. 4 will show that quite a difference could be

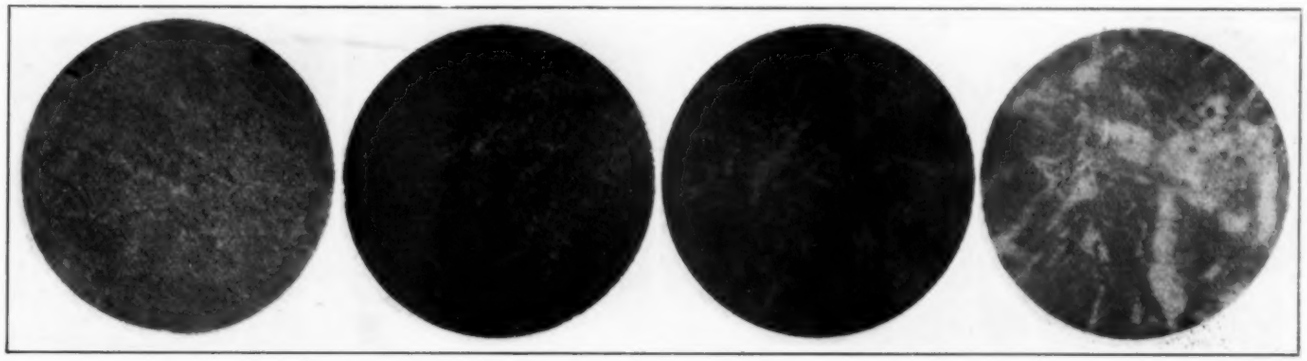


FIG. 3 FIG. 4 FIG. 5 FIG. 6

PHOTOMICROGRAPHS TAKEN BY A MACHINIST

made in the appearance of Fig. 5 by taking different parts of Fig. 4, and still more difference in the appearance of Fig. 6. This is because the marking of Fig. 4 is not uniform over the entire surface and Fig. 5 only shows a part of Fig. 4, while Fig. 6 only shows a part of Fig. 5.

Repeated trials showed that it did not make any difference how the etching was done; if it was not overdone, the piece would show the same characteristic marking.

To show how easy it is to go wrong even when following the practices of a scientist, I will tell my experience in taking the photographs. My book said that it was hard to judge of the time for correct exposure. It might vary from ½ minute to 20 minutes. That rather scared me, for my experience has been that I am apt to over-time. I exposed for 5 seconds and now think that 2 seconds would have been more nearly right.

The United States warship "Michigan" is the oldest iron ship in the world, according to a paper presented before the Society of Naval Architects and Marine Engineers in recent convention.

A Regenerative Reverse Planer

By J. W. Carrel

A regenerative, spring-balanced platen planer, built by Joshua Buckton & Co., Ltd., Leeds, England, is shown by the acompanying half-tone illustration. Its size is 48x48 inches by 10 feet, and is shown with two heads on the cross rail and one on the front housing. It is motor driven with the motor located on top of the arch, provided with a balance wheel on its armature shaft and connected with a gear box that gives three cutting speeds, which are, 20, 40 and 60 feet per minute, respectively. The transmission from the gear box to the planer is by means of the belt shown near the left-hand housing. The reverse is constant at 180 feet per minute and is driven from the large pulley and wide belt near the right-hand housing. The cross-rail raising and lowering mechanism is driven by the smaller belt at the right-hand side of the machine, coming from the countershaft which is behind the arch, and which in turn is driven by a belt from a small pulley near the balance wheel. The starting, stopping and reversing of the planer are accomplished by the large hand wheel shown in front of the head on the right-hand housing.

Aside from these noteworthy details, the special feature of the machine is the use of recoil springs for absorbing the kinetic energy of the platen prior to the instant of reversal, and restoring this energy during the period of acceleration of the platen after reversal. Two recoil springs are provided, one of which shows plainly in the illustration; the other is at the other end of the bed. They are arranged on two long screws, one on either side of the platen's rack. These screws pass the entire length of the bed, and by means of their adjustable nuts, control the length and position of the stroke of the platen. This length of stroke can be adjusted down to 12 inches. To change the length or position of the platen stroke nothing else is required to be done but to turn the screws, and bring the nuts that control the reverse into proper position. One of these is shown in the illustration on the screw beside the recoil spring.

While the return stroke of the machine

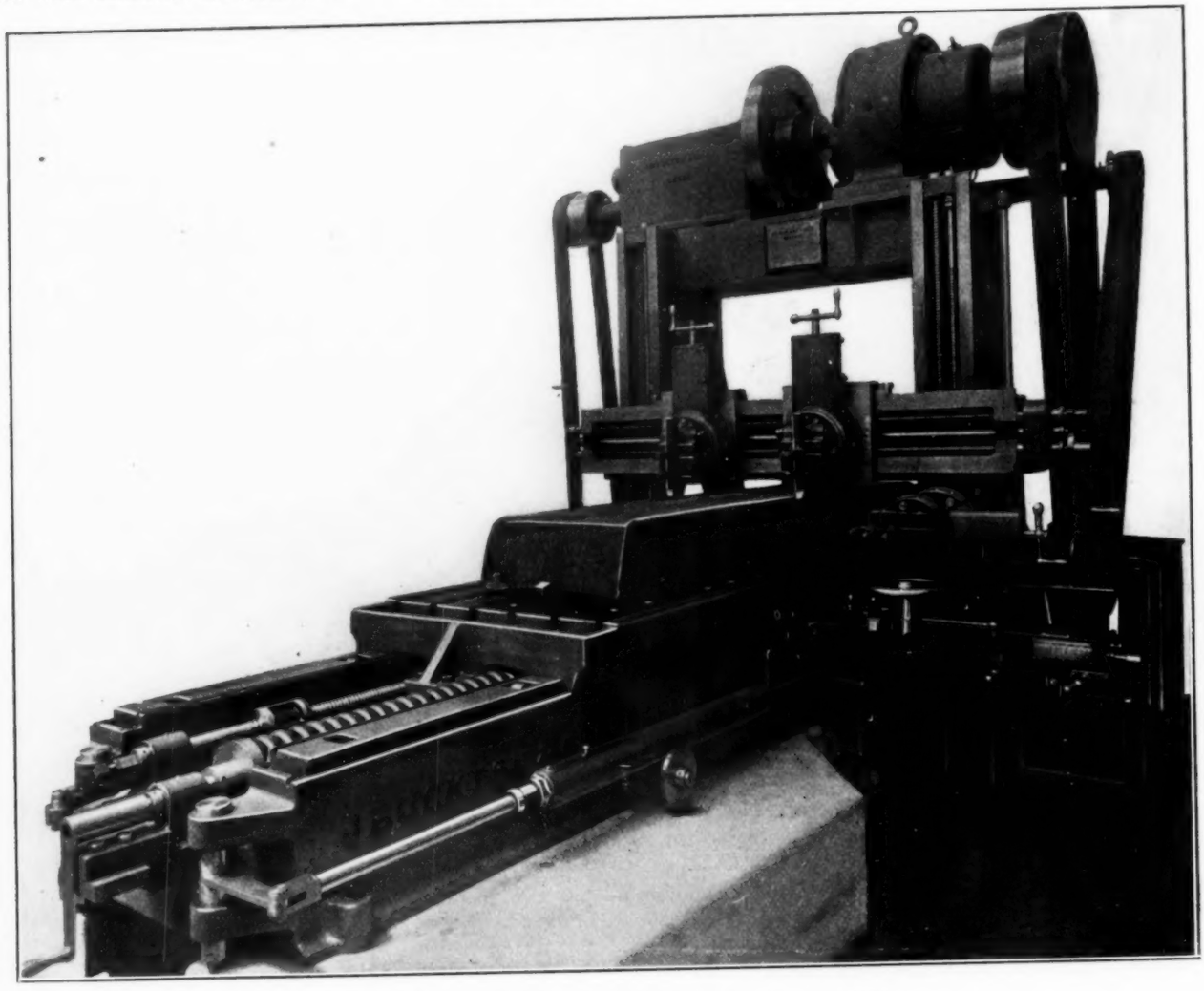


FIG. 1. AN ENGLISH REGENERATIVE SPRING BALANCED PLANER

takes place at the high speed of 180 feet per minute, the cutting stroke can be varied through the changed gearing, as has been indicated. Although the limits of the range of speed, which gives the slowest cutting speed of 20 feet per minute and a corresponding return speed at the rate of 180 feet per minute, and in the ratio of 9 to 1, yet no adjustments are required between the highest and the slowest speeds, and there is no difference in the accuracy of the line of reversal. Changes can be made in the length of stroke when the planer is in operation.

The work shown on the platen in the illustration is a steel ingot 22 inches wide by 8 feet 2 inches long and weighing 3 tons. The curves shown in Fig. 2 were developed by a Kelvin recording ammeter in circuit with the 20-horsepower motor driving the machine. For each of the curves the cutting speed is 40 feet per minute, and the return 180 feet per minute. In curve *A* two cutting tools were in use, taking cuts 3/8 inch wide and 1/16 inch deep. In curve *B* two tools were in use, taking cuts 1/4 inch wide and 1/16 inch deep. In curve *C* the planer was running light without any cutting tools in use. Turning to curve *A* it is seen that the horsepower required for the cutting stroke is greater than that which is required at the peak of the curve of reversal. This is a remarkable showing, and especially so to anyone who has watched the swing of ammeter needles of instruments in circuit with a motor driving an ordinary type of planer. In curve *B* it will be noticed that the peak of the curve of reversal is practically identical with the peak of the curve of reversal in curve *A*. At the same time the peak of the cutting curve is slightly lower than the peak of the reversing curve. This latter condition is dependent upon the amount of power required by the cut and by nothing else.

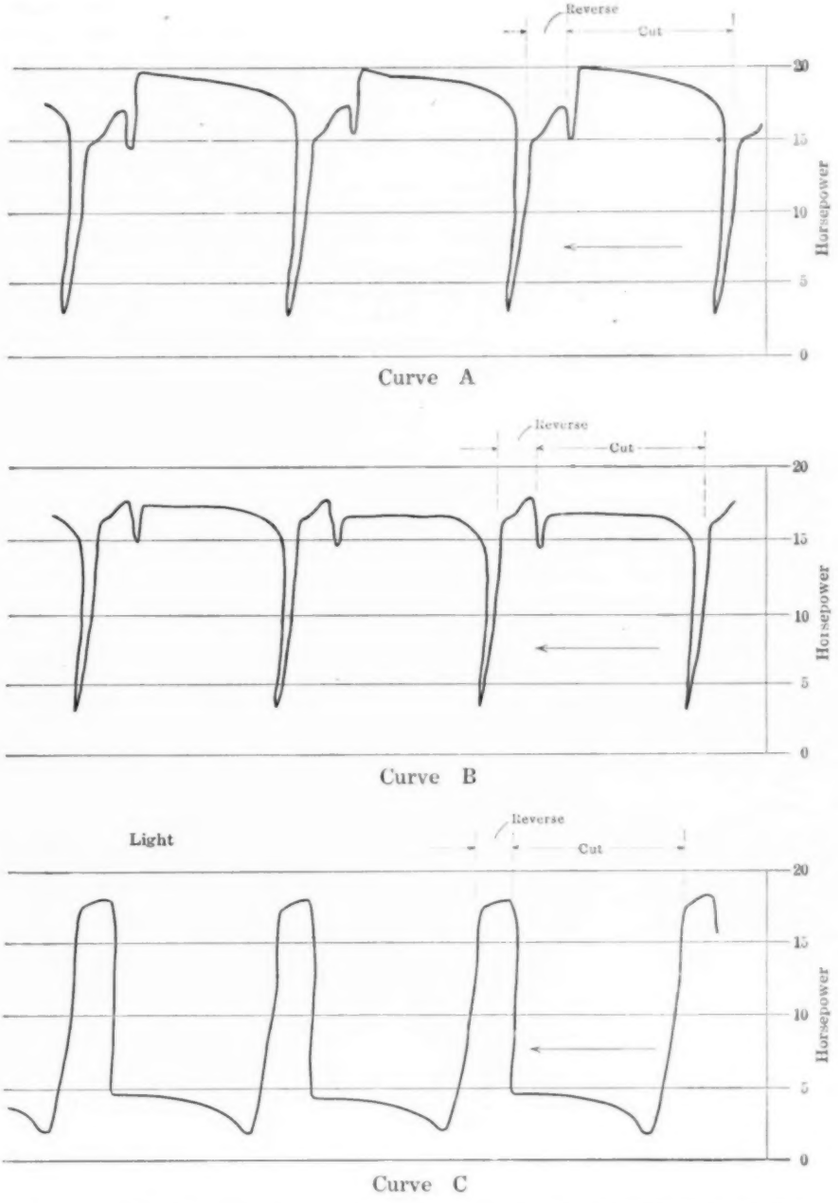


FIG. 2. CURVES SHOWING HORSEPOWER CONSUMPTION OF REGENERATIVE PLANER

Turning to curve *C* we again see that the peak of the curve reversal is at practically the same point as in the cases of curves *A* and *B*. Of course, the cutting curve is much lower, as the planer was running light.

The remarkably slight variation from a constant average in the case of curves *A* and *B* is worthy of considerable study; for the problem of properly controlling the platen and its forces in a planer using high-speed steel tools is a very real one, as it is now presented to planer manufacturers. The saving in power consumption is another item that should not be ignored.

Drawing Dies of Air Hardening Steel

By A. H. Steel

Our production of ferrules was about a million a month, and it kept one toolmaker busy repairing and making drawing dies. The ferrules were blanked from steel, good, bad and otherwise. The first operation consisted of blanking and partially drawing, next redrawing to a finished size, then trimming and piercing. The blanking dies stood up as well as could be expected considering the stock, but the drawing dies brought the cuss words and the gray hairs, when we looked at the cost sheets; they would run from three to four thousand, then commence peening or cutting and have to be taken out and polished up.

We had been having excellent results with air-hardening steel for burnishing tools so I made a drawing die of it; it ran 92,000 without cutting and then broke in half. For the next one I bored a hoop of machinery steel about 1/2 inch thick and of suitable size to fit the die plate, reducing the air-hardening die to fit the hoop. After hardening the die I shrunk the machinery-steel hoop on the die, giving it all the draw it would stand, thus compressing the hardened die; this one ran 100,000 before cutting and repeated it over twenty times before it was worn too large, the limit being 0.010 inch.

We are making all our drawing dies that way now. Our blanking and trimming dies are large enough to stand the stress without resorting to "ordinance construction." Dies cost but little more to make and have more than double the life of a carbon-steel die. We are now able to look at the cost sheets on ferrules with a serene countenance.

There once was a cranky machinist
Whose tactics were always the minist,
But as is always the way,
When it came to pay-day,
His envelop, too, was the linist.

Practical Letters from Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

A Boring Tool for the Milling Machine

The drawings illustrate a stiff boring tool for the milling machine. This tool will be found a very valuable addition to the tool-room equipment where accurate work is required. The construction is shown clearly in the assembly and detail drawings and no explanation is required.

Indianapolis, Ind. J. F. MORGAL.

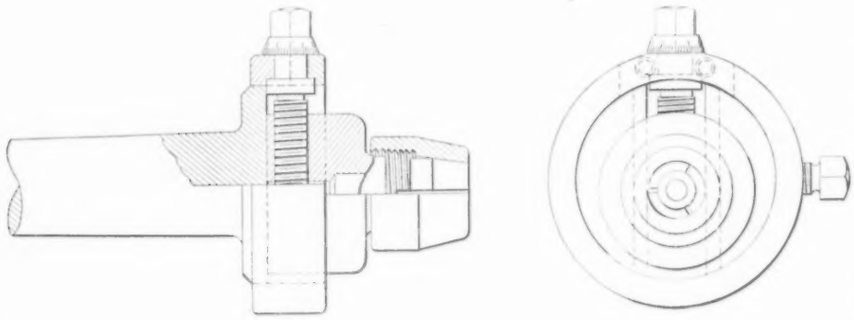


FIG. 1. BORING TOOL FOR THE MILLING MACHINE

Experiences of a Grinding Machine Demonstrator

About a year ago I began to demonstrate a line of grinding machinery in the East and middle West. Some of my experiences may be of interest to others.

With all grinding machinery, it is important that the countershaft should run at nearly the correct speed. Where our blueprints call for 700 to 720 revolutions per minute, I have frequently found the countershaft running as slow as 600 revolutions per minute. Usually this is because the millwright or superintendent, or whoever had charge of the work, did not know the line-shaft speed, and did not take the trouble to count it.

In one case a company had one machine and bought another. They wrote that the new machine was not working very well. When I got there I immediately tried the counterspeed and found it running about 11 per cent. too slow. The foreman couldn't account for it. He said he had counted the revolutions of the line shaft, and used the same size pulley as for the old machine.

This floor was served by two line shafts, each driven by its own motor. The shafts ran at different speeds and the foreman had *counted the wrong line.*

In another instance two machines were used, and the driving pulleys on the line shaft were side by side, but one was *two inches* larger than the other and neither was large enough to give the proper speed. The assistant superintendent who had charge, remarked that the pulleys were up when he first came there, but that he had not noticed the difference in

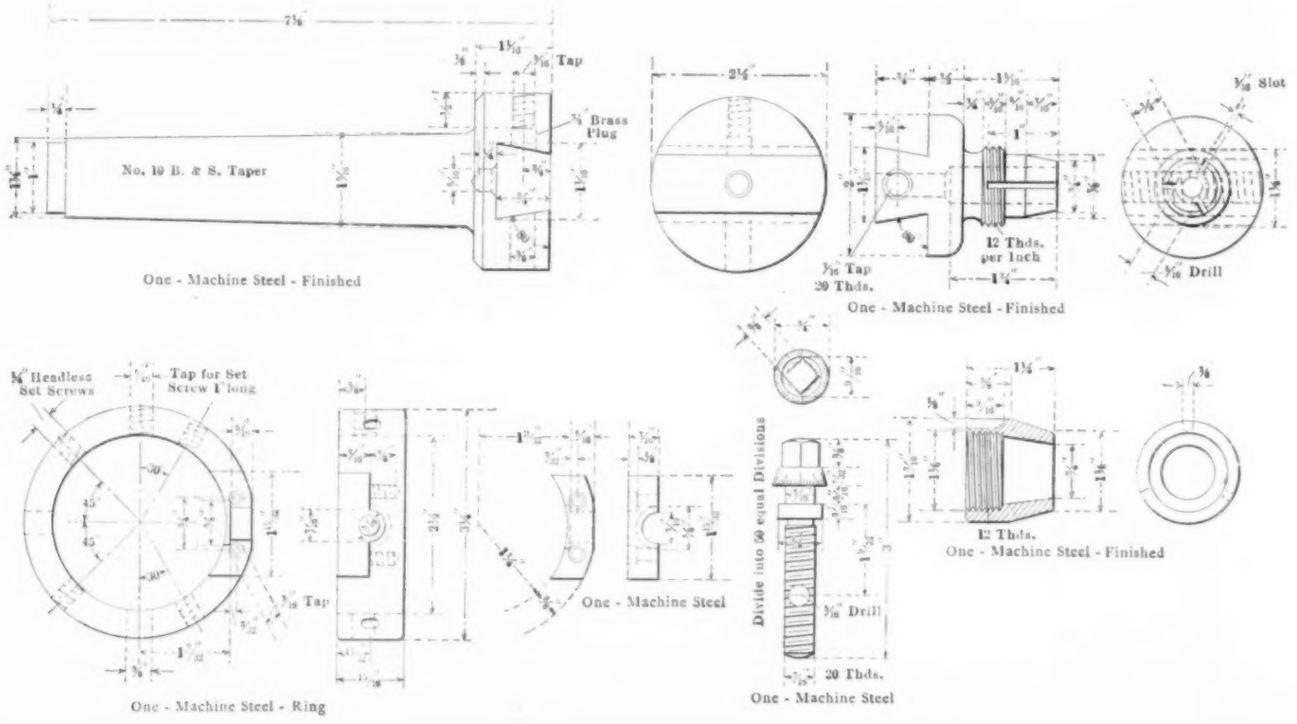


FIG. 2. DETAILS OF BORING TOOL FOR THE MILLING MACHINE

sizes. When asked how long he had been there, he replied, "About a year and a half."

As these machines grind dry, it is essential that an exhaust system be used to carry off the dust. I found at one place a fair-sized exhaust fan, apparently running at proper speeds, but there seemed to be very little suction through the inlet pipe. Outside the building I found a 5-inch diameter outlet, led into a barrel through a piece of heavy burlap. The burlap was swelled up like a balloon, while there was a *single inch and a half* hole in the side of the barrel.

Boston, Mass. W. CHAPIN.

Double Jaw Lathe Chuck

Many of the standard lathe chucks on the market present the disadvantage of having a very short gripping surface, and when used for long rods often give poor results, due to the fact that the revolving rod being insufficiently supported at the end is constantly tossed about.

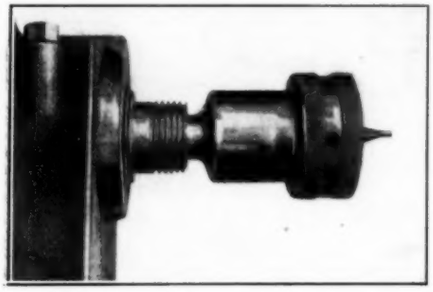


FIG. 1. THE CHUCK IN THE LATHE

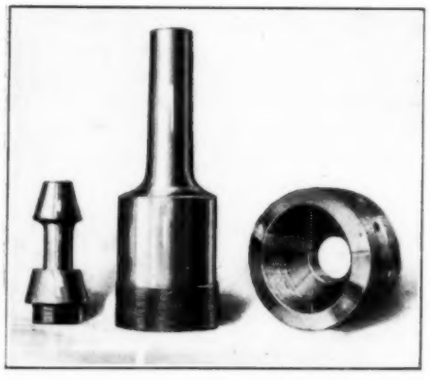


FIG. 2. THE CHUCK TAKEN APART

I take pleasure in presenting to the readers of the AMERICAN MACHINIST, drawings and photographs of the Seng chuck, designed, and in use at the plant of the Seng Company, Chicago. This chuck was especially built to hold drill rods from ¼ to ⅝ inch diameter, from which are made punches for blanking dies without turning down the body of the punch.

The chuck is shown in Figs. 1, 2 and 3. It is very simple in its construction and operation. The body is made of bessemer steel and may be cut from a 3-inch bar, centered and taper-fitted to the lathe in which it is to be used. It is then put into this lathe and finished completely. The cones should be ground to make them perfectly smooth. The nut is made from 4-inch mild steel. It is case-hardened and may be turned with a spanner wrench, holes being provided, as shown.

Collets of the required sizes are made of tool steel and hardened; they have very little draw and will, therefore, not permit of large variation of sizes in rods. Great care should be taken in tempering these collets, making the center between the jaws as soft as possible; they are easily broken otherwise. Slots should be cut with a very thin saw (about 1/32 inch will do), then the jaws spread slightly before hardening to allow bars to enter easily.

I think the drawings and photographs illustrate the principle fully, the cones of the collet acting or bearing against those in the chuck draw the former in, giving an even, double grip. This chuck is inexpensive and can be made in almost any shop with ordinary tools.

Chicago, Ill. ARTHUR F. KUNZE.

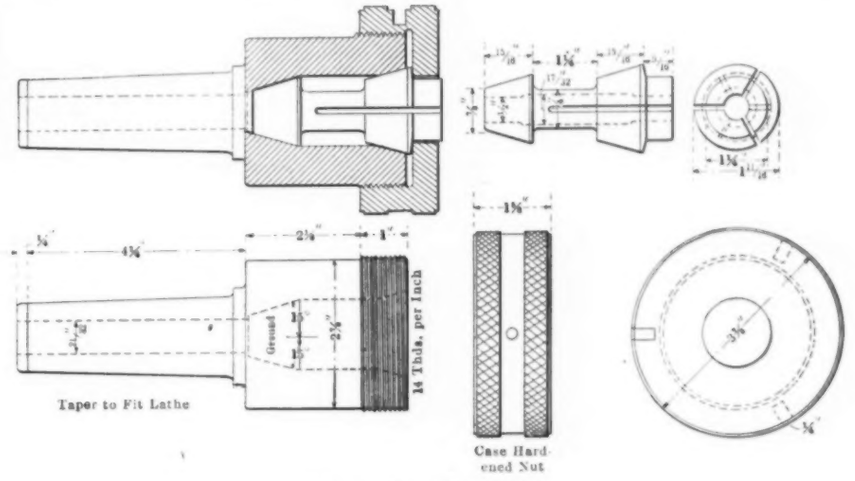


FIG. 3. CHUCK DETAILS

The Effect of a Blow

The mechanical engineering department at the Worcester Polytechnic Institute has inaugurated a new plan to provide speakers for the season's meetings of its mechanical engineering society. Since these meetings are public, and I happened in Worcester at the time of the first one, and came away with clearer ideas than I brought with me, I need no apology for writing down what I got out of it. Professor Bird, the head of the department, was the speaker, and his subject was "The Effect of a Blow."

DISTINCTION BETWEEN WEIGHT AND MASS

He first illustrated the distinction between weight and mass by means of a heavy ball suspended by a fine wire. In order to feel its weight he had only to lift on the wire; to feel its mass he pushed it to one side (the wire was long enough so that its path was practically horizontal for an inch or two). He showed how he could pull the weight to one side with a small rubber band, if he took time enough, with only a trifle stretch, while by a quick pull he stretched the band to the breaking point without perceptibly stirring the weight; all of this helped me to get a more realistic impression of the relation than before.

Professor Bird also confirmed my use of $M = \frac{W}{g}$, which C. P. H. B. took exception to at page 211, on the score that I should have used $\frac{W}{2g}$. By the way, I have searched diligently for C. P. H. B.'s justification in using this expression, but have only found it referred to by Weisbach in the edition of 1870, where he refers to it as exclusively German usage and deplore that at that date it was still used by some engineers.

The speaker used his distinction between weight and mass as an illustration of the difference between determination and pigheadedness. In lifting the weight nothing will stir short of a pull equal to its entire weight. In overcoming its inertia, due to its mass, a force no matter how small if applied long enough will move it any distance. Thus determination applied to any task where it will produce any impression will ultimately conquer, while if it is applied to a task on which it produces no immediate impression it becomes pig-headedness.

Professor Bird also spoke of the strong man who claimed to be able to hold a horse at tug-o'-war. The first horses brought against him were city horses used to starting a load by a yank and then letting up to keep the wagon from rolling on their heels. The man could hold these horses, but had to give up the contest when someone brought up a canal horse that was used to setting his toes into the dirt and waiting for something to happen.

Hammers

He then went on to discuss the different forms of hammers used by different workmen, saying that he was not prejudiced from a scientific standpoint, but preferred to let workmen evolve their most satisfactory forms and then try to find a scientific reason for their use.

To illustrate: A carpenter's hammer is made with a handle short and comparatively thick as compared with a machinist's chipping hammer. A carpenter when he strikes a blow expects the nail or the chisel which he is striking to yield considerably; this reduces the jar on his hand and arm. On the other hand, a machinist does not expect his pounding to produce much travel of his cutting tool per stroke, and, therefore, he needs the elasticity of the handle to relieve his arm. A blacksmith's hammer being used for work in which the give of the material is intermediate between these two has a handle intermediate between the two. The fact that all workmen wish a hammer made so that the center of gravity of the head travels in advance of the handle the speaker laid to the righting power which such a hammer would have as it descended, and which would help to make the hammer strike squarely. A man wielding a hammer will voluntarily cease pushing on it just before it strikes, and if he is a blacksmith and wishes to do smooth work he will drag back on it so that if its center of gravity is in advance of the handle it will strike more fairly.

The Pile Driver

Professor Bird then illustrated the effect of a blow by means of a pile-driver model, with which he drove spikes in a chestnut joist. A weight of 6½ pounds falling 45 inches drove a spike 1 inch. If the resistance of the wood to the penetration of the nail had been constant then the force of the blow would have been found by the formula

$$W h = F d,$$

where W is the weight of the hammer, h its drop, d the distance the nail was driven and F the force of the blow in pounds. Figured on this basis the blow would have been 292.5 pounds, which probably is a fair average value since the resistance of the wood increases as the depth which it penetrates into the wood increases.

Attempts have been made to arrive at the force of a blow by striking cubes or cylinders of soft metals, but in such experiments the time element must be considered, since the flow of metals under a much less constant force may be as great as that produced by the blow.

The difference in the shape of a hammer was also illustrated by two drops of equal weight, one a cube, the other long and narrow. The long and narrow one produced a little greater effect than the cube, which was accounted for by the greater concentration of the weight immediately above the nail. This effect is taken account of in the design of pile drivers, the hammer being little, if any, larger in diameter than the largest pile which it is intended to drive.

The effect of a body interposed between the falling weight and the spike was illustrated by putting a cast-iron chunk, about 10 inches long, on the spike. It reduced the distance which the spike was driven by about two-thirds; the rest of the possible effect was taken up by the inertia of the interposed block and the setting up of useless vibrations.

In all it seems that what we really care about is not the force of the blow, but what it will do. A hammer of given weight, traveling at a given velocity, will do a given amount of work, useful or otherwise. The force exerted will be greater the greater the resistance to the blow. Thus a carpenter does not usually exert nearly so much force on a nail head as a machinist does on a chisel. From this it does not follow that a carpenter is any less strong, but only that he makes more of a show.

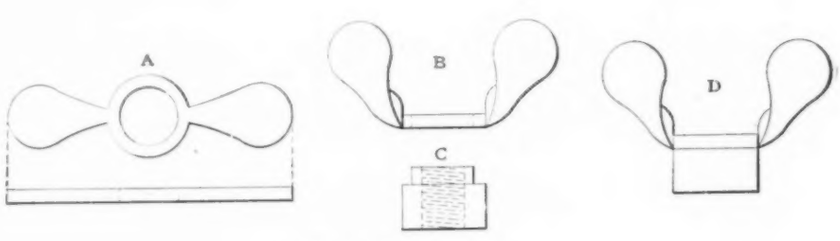
Springfield, Mass. Entropy.

A Built-up Thumb Nut

Cast-brass thumb nuts are not always the simple thing to make that they look to be, especially when they are required to be finished; the castings are of so many different shapes and sizes, owing to the molder rapping the pattern to get it out of the sand. In machining some prefer to hold by the hub; some use a two-jawed chuck, others prefer a spring collet, but there are always a good many that are unsightly after they are machined. And even if they were good after machining, they would require to be filed and the polisher would not be able to get the file marks out. Most I have seen have had polish and deep scratches. The sketches show a built-up nut. *A* is a punching of sheet brass which is formed like *B*, giving the wings a quarter twist. *C* shows a hub made from cold-rolled steel with the small diameter turned down and nurled straight. It can be made in one operation on the automatic screw machine. The nurled part is forced into the hole in the center of the wings and being of harder material it will seat the nurled teeth going in. This will hold against all side strain and a slight riveting on the top will keep it from coming off. *D* is the finished nut. Both metals being bright, no filing or polishing will be required and a finished nut will be turned out. Some may think it weak, but it's strong enough for a thumb nut providing the monkey wrench is kept off.

W. M. McKenzie.

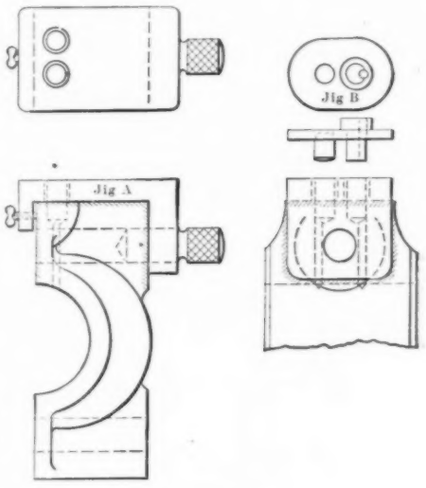
New Rochelle, N. Y.



A BUILT-UP THUMB NUT

Oil Hole Jigs

The drawing shows a connecting-rod box on which we used a sight-feed lubricator which had to be set back from the edge of the box in order to clear the moving parts and the oil hole had to be far enough from the center to escape the hole for the connecting rod. The sketch of the box shows two sets of holes, but as a matter of fact we used only one on each box; but they were right and left, so that it was necessary to have them in the jig both ways. The sketch shows the jig *A* in position to drill the holes for the pipe tap to suit the oil cup, and jig *B* is made to fit jig *A*, it being provided with a stump to fit one hole and an eccentric bushing to fit the other hole and drill the oil hole proper. The proper way, it was found, was to drill the small hole first.



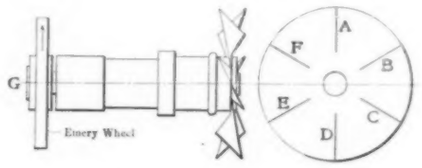
OIL HOLE JIG

Bridgeport, Conn. Isaac Morgan.

Mounting a Fan on a Grinder Spindle

While operating a grinding machine I was troubled very much with the emery dust, etc.

The line cut will give you some idea as to how I got over this difficulty. I took a piece of galvanized-iron sheeting and laid it out as per drawing. After drilling hole and cutting lines *A B C D E*



A FAN ON A GRINDER SPINDLE

and *F*, I fixed it onto the machine spindle and twisted each section until I had a sort of fan.

The work being ground was cams and the table traveled in a line with the emery wheel so that I worked the machine from position *G*.

The fan drew all the emery dust, etc., from the wheel and blew it away at the back of the machine.

New Haven, Conn. JOHN R. JARVIS.

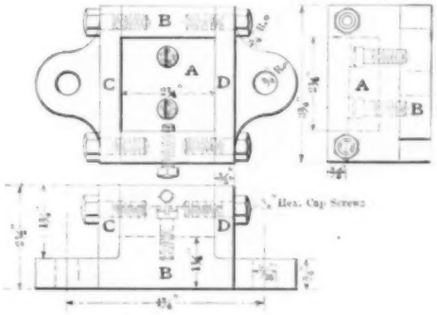
Jig for Valve Blanks

This jig is for handling steel valves in a drill press. The drawing shows the finished valve which is made from pieces cut off a steel bar 1/32 inch larger than the finished size of the valve. The jig body is a block of steel bored to receive the valve blanks with three holes for the end mill which cuts away the three flutes on the valve, and also a hole for the small center drill. The adjusting screw at the bottom is also bored for a drill with 60 degree point to ream out the large center with the jig reversed; the valves are then bored, slotted and finished on the lathe, the center with slot and key (as shown), being used to drive them. The jig block swings off the base to allow the work to be removed and new blanks to be inserted.

Bridgeport, Conn. ISAAC MORGAN.

Milling Fixture for Die Sections

The milling fixture illustrated by the line drawing will be found convenient for machining duplicate parts, such as sections



MILLING FIXTURE FOR DUPLICATE DIE PARTS

of armature dies and work of a similar nature.

By making the bottom plate or pad *A* separate, several can be made of different outlines, corresponding to those of the work, thereby saving the cost of making an entire new fixture. Also it will be noted that there is no tongue on the bottom of the holder or box *B*, the reason being that a finer adjustment can be had by setting the fixture with the aid of an indicator.

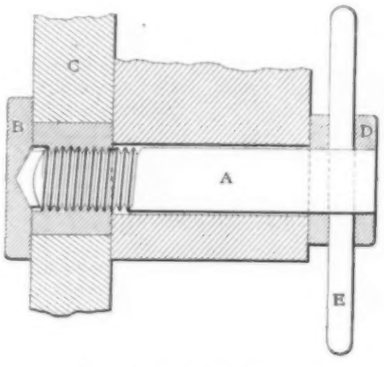
The dimensions given are suitable for armature die sections, they usually being 2¼ inches long and of a width not exceeding the capacity of the jig, which in this case is also 2¼ inches. The end pieces *C* and *D* grip the work while the set screw keeps it against the back of the fixture.

The set screw can be made with wings, if desired, to be used as a thumb screw. The fixture, as a whole, is simple in construction and produces satisfactory work.

Boston, Mass. CO-ORDINATE.

A Slip Stud for Jigs

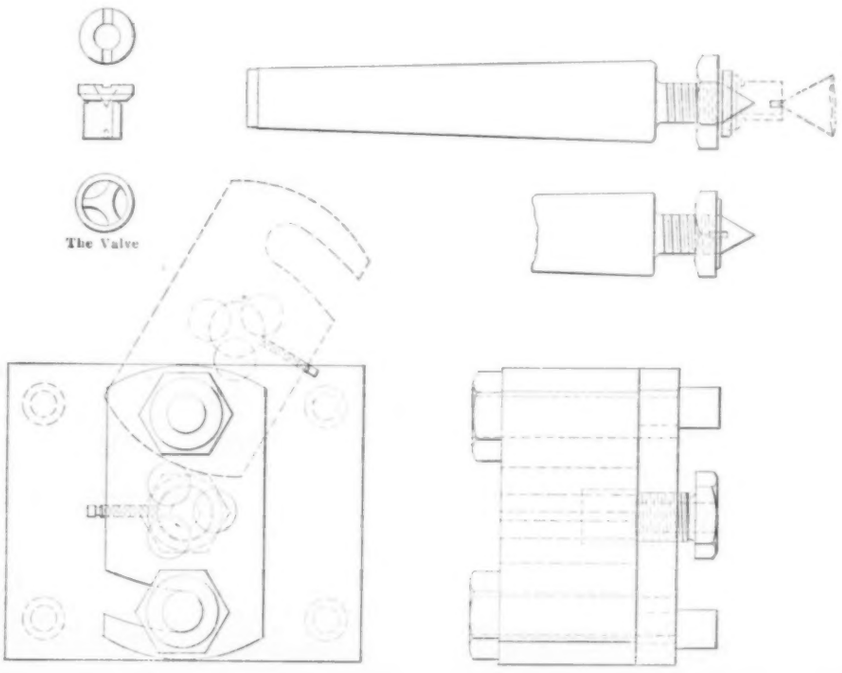
Having to make a jig for drilling a large number of brake shoes, I hit upon the following device for holding, and very



A SLIP-STUD FOR JIGS

quickly releasing the work: The work is located by two studs, one 1½ inches diameter and the other ½ inch; the larger stud being turned down to ½ inch diameter and threaded to take a nut and U-washer. The second stud *A* is screwed into a mild-steel plug *B* let into the body of the jig *C*. The plug *B* is made simply to save wear on the cast-iron body and to be easily replaced when worn. A collar *D* is then turned and bored to be an easy fit on the stud *A* and then both the stud and collar are drilled to receive a 3/16 steel pin *E*, 2 inches long. When the collar is placed on the stud and the pin pushed through the holes a half turn will hold the work, the thrust being taken by the pin. To release the work a half turn of the stud loosens the pin and allows it to be drawn out, so that the collar and the work can be removed at the same time. This device was made to take the place of an ordinary stud and nut, the removal of the nut not being quick enough and the size of the hole, viz., ½ inch, would not admit of U-washers being used. I have adapted it to several jigs now in use, finding it very satisfactory and a great time saver.

Birmingham, England. T. B. G.



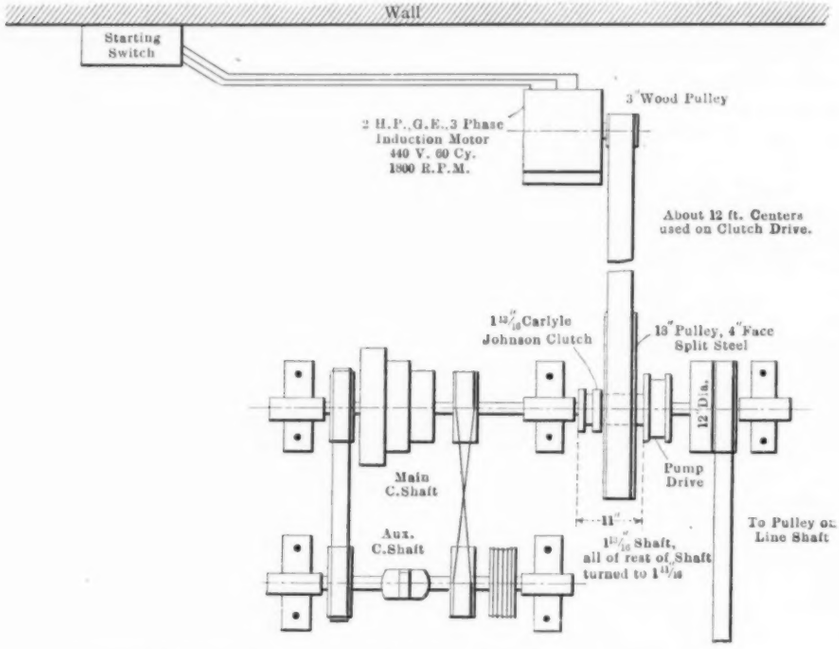
JIG FOR VALVE BLANKS

A Combination of Individual and Line Shaft Drive for a Thread Milling Machine

The accompanying sketch shows a combined individual motor drive and line-shaft drive which I applied to a 6x14-inch Pratt & Whitney thread-milling machine. The production demanded of the machine required a 20-hour operation of this machine to a 10-hour operation of the rest of the factory. The plant was under-equipped with thread millers which were just being introduced. The department line shafts were driven by a 35-horsepower motor, generating power for about 75 machines. The extra power required during the day to drive the thread miller had practically no effect on the power consumption of the large motor, but the power consumption of the idle shafting and loose pulleys at night and the wear and tear occasioned by their 20-hour operation were sufficient to render advisable the installation of a night drive independent of the main department drive.

The sketch shows how a Carlyle Johnson friction clutch was used for this purpose. The countershaft for the miller was 1 11/16 inches in diameter, but it was deemed inadvisable to use a smaller clutch than 1 13/16 inch, so a piece of this size of shafting was turned down to 1 11/16 inch except where the clutch was located. An 18-inch split steel pulley was mounted on the clutch and belted to a 2-horsepower General Electric induction motor, 440 volts, 60 cycles, 1800 revolutions per minute, with a 3-inch pulley. The usual clutch shipper was put up to operate the clutch.

During the daytime, the clutch shipper was thrown to allow theshaft to run free in the clutch sleeve and the small motor was shut down. At night the line-shaft connection was shifted to the loose pulley and the countershaft allowed to run free inside it in like manner. No trouble was caused by throwing the wrong shifter. This happened but once. When it did happen one night, the motor belt simply slipped off of the 3-inch pulley.


Wall
Starting Switch
3" Wood Pulley
2 H.P., G.E., 3 Phase Induction Motor 440 V. 60 Cy. 1800 R.P.M.
About 12 ft. Centers used on Clutch Drive.
1 13/16" Carlyle Johnson Clutch
13" Pulley, 4" Face Split Steel
12" Dia.
Pump Drive
Main C.Shaft
Aux. C.Shaft
11"
1 15/16" Shaft, all of rest of Shaft turned to 1 11/16
To Pulley on Line Shaft

INDIVIDUAL MOTOR DRIVE FOR THREAD MILLER IN CONNECTION WITH REGULAR LINE SHAFT DRIVE

This method of drive is applicable to automatic screw machines and machines with complicated overhead works. Without the line-shaft connection it is suggested as a means of applying individual motor drives to machines which must be started without shock, or require a considerable starting torque.

In operation, the motor is allowed to run continuously and starting and stopping are done entirely by means of the clutch. The average number of stops and starts per day on this machine was 175 in ten hours. Excessive wear on switches and motor due to careless starting of the motor was also largely eliminated.

ARTHUR FREDERIC.

Philadelphia, Penn.

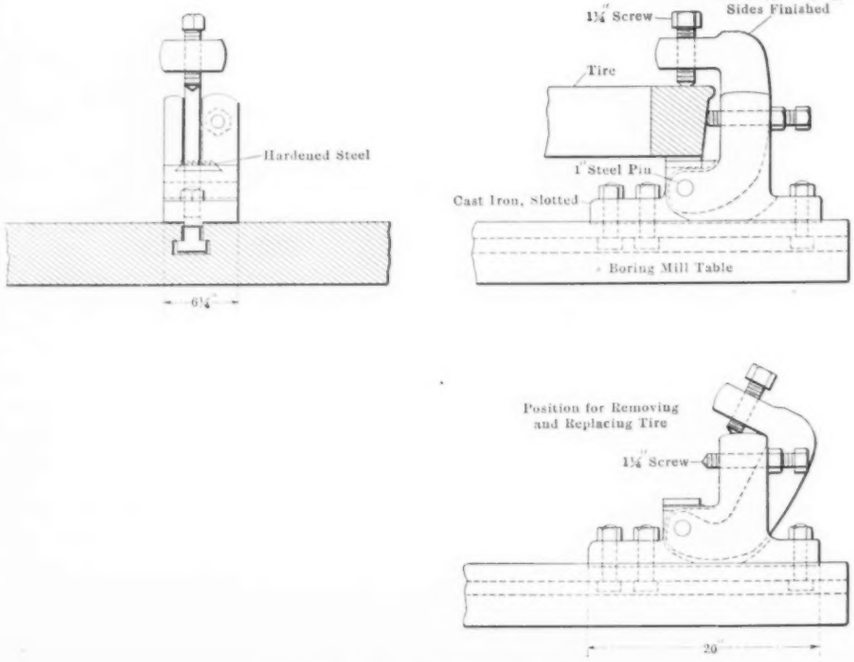
Holding Driving Tires

I inclose a sketch of a boring-mill clamp for holding "driver tires" while being bored to size.

This clamp was designed especially for use in fitting driver tires on the contract or piecework basis. It is easily evident from inspection of the sketch that the necessary adjustments for removing and placing tires may be made in minimum time.

When the tires have the same outside diameter the only adjustment required is the tightening of the "holding-down screws," while a slight variation in the outside diameter will necessitate a small adjustment of the "truing-up" bolts also. This device has proved to be a great improvement over the "link-and-blocking" method which is still in use in some shops.

Cortlandt, N. Y. W. S. DRUMMOND.



CLAMP FOR HOLDING A DRIVING TIRE

Power Presses and Press Work

Even among mechanical engineers not many realize the possibilities of cold work in bending, drawing and compressing ductile metals to finished shapes and dimensions by means of dies in power presses. From both a commercial and a mechanical viewpoint, utility articles, from a thimble to a bath-tub, are successfully made cold from sheet-metals by drawing or "striking up." The extent to which metals may be successfully condensed by compression cold is remarkable. Practically the limit to this is only in the securing of dies to stand the pressure.

In much of this work the power press is indispensable. And in most of it the press is preferable to the drop, or other, hammer. In some hot work, such as forgings, where considerable flow of metal is required the hammer is perhaps preferable.

Mr. Longstreet, on page 95, Vol. 31, Part 2, gives an illustration of a simple and practical operation for shaping, sizing and truing malleable articles in which the danger of fracture is practically nil. But in a reverse operation, that of stretching and enlarging the articles, a thing often desirable, the danger of rupture is ever present. In good malleables, however, and where the cross-sections are practically uniform, as in a bar or ring, it is practicable to stretch the metal 15 per cent., or more, cold.

In the operation described by Mr. Longstreet he attributes the new conformation of the article treated to the flow of the metal, "all of which" he says, "goes to thicken and lengthen the walls of the article." Doubtless in this instance this is largely true. But had the articles been measured before and after the operation it would probably have been found that the metal had been more or less condensed in the operation.

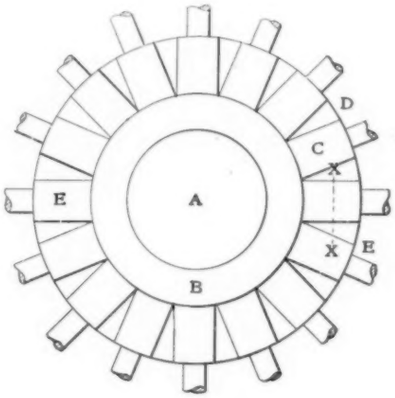


FIG. 1. WHEEL WITH SPOKES INSERTED READY TO PRESS

Several years ago I conceived and patented the idea of securing the spokes in metal wheels by compressing cold, the hubs being malleable. At first I had no doubt the thing could be done in a hydraulic press, but failed to find one sufficiently powerful, and had to design and make a back-geared toggle-joint movement press which did the work fairly well. But the trade demanded heavier work and I designed and built a heavier press on practically the same plan as the first but with a resistance capacity of ten thousand tons and this machine met all the requirements.

To give some idea of the pressure required in such work I take as a sample a 7-inch diameter 16-spoked malleable hub, with a 3-inch axle-hole, which has suitable mortises to receive 7/16 inch by ⅞-inch soft-steel oval spokes. The hub is 1 5/16 inches in thickness, and flat ¾ of an inch out (measuring from the axle-opening), the remaining 1¾ inches being corrugated to conform as nearly as may be to the shape of the spokes.

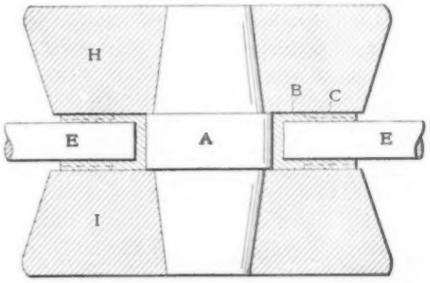
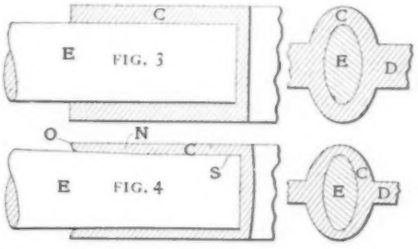


FIG. 2. HUB BETWEEN THE STEEL DIES



SECTION THROUGH SPOKES BEFORE AND AFTER PRESSING

The dies, top and bottom, are made to embrace the entire faces of the hubs, with a small margin both inside and out, and made to exactly fit the hub faces. Thus it is seen that the thing to be acted upon by the dies is practically a solid ring, presenting a surface of 31½ square inches.

In this work it is necessary to compress the hub ¼ inch, or 20 per cent., at its maximum, and nearly 100 per cent. at its minimum thickness.

By reference to the drawing, Fig. 4, it will be seen that there is a perceptible flow of metal at the outer ends *O* of the spoke-bosses, very little at the inner ends *S*, and practically none at the middle *N*.

I have no means for accurately measuring or indicating the pressure required in this work. But multiplying the 31½ square inches by the constant 90,000 pounds, which is the resisting strength of cast iron, gives 1,417½ tons. But this is not sufficient to do the work, as the resistance increases as the compression progresses. Figuring from observed straining effects of the work on the machine in the way of stretching the tie-bolts that secure the cap or head-beam of the machine, I find the work requires a pressure of not less than about 6000 tons, or about 190 tons to the square inch.

Fig. 1 is a reduced plan view of the hub described above, and shows the axle, or box, and skein opening *A*, the flat center ring *B*, the corrugated outer portion *C*, and the web *D*. This latter serves the important purpose of holding all parts of the hub in shape, and in their proper relation, while being pressed. Otherwise it would be distorted by the flow of the metal. It also gives strength and support to the spoke-bosses *C* when in use.

Fig. 2 is a reduced vertical sectional view of the hub and of the tempered steel dies *H* and I.

Fig. 3 is a view of a cross-section at *x x*, Fig. 1, and a longitudinal section of the same, before being pressed. It shows portions of the web *D*, of the spoke *E* and of the spoke-boss *C*.

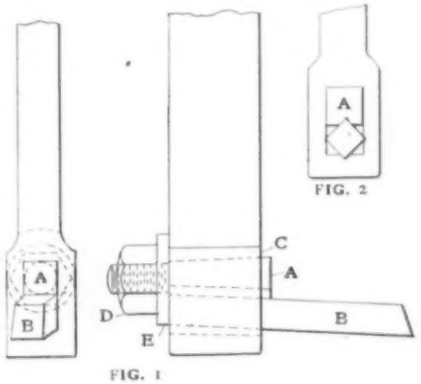
Fig. 4 is a similar view of the same, after being pressed.

Quincy, Ill. J. R. LITTLE.

Handy Shaper Tool

The sketch shows a long-nose shaper tool which I have found very handy for die work in shops where they have no slotters or profilers. As the sketch shows, it is made to hold square stock.

A, Fig. 1, is the wedge which is tapered to fit between the tool *B* and the top of the slot *C*. The wedge has ⅛-16 thread cut on one end by which it is drawn up by the nut *D*. *E* is a washer which also acts as a stop for the cutter.



A HANDY SHAPER TOOL

Fig. 2 shows the wedge and bottom of the slot with a 45-degree notch in each to hold the stock so it can be used as a diamond point.

Kenosha, Wis. F. S. MCGRATH.

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

Quill Pen Making

The article "Modern Methods of Making Steel Pens" on page 595, Vol. 31, Part 2, reminds me of a quill pen die bought many years ago, I believe, by my father for my mother.

Quill pens are still used in conservative England, especially by lawyers, and can be bought either in the shape of uncut goose quills or as finished pens. The average quill pen user as a rule prefers to cut his own pens. For those accustomed to use a knife it is not, with a little practice, a difficult job to make a fairly good quill pen, but as the average woman cannot handle a knife it was probably on their account that the quill pen dies were first made.

When in England recently I saw another pen cutter which I bought as a souvenir for a friend who has written quite a lot on die work for the AMERICAN MACHINIST. He has lent it to me for this article and I reproduce it together with the one used by my mother.

Fig. 1 shows the *pen* knife *B* (this is the origin of our word "penknife" for a small pocket knife), extended. The little button on the side at *A* is fastened to a spring to which the blade is secured. The slot *C* has an enlarged opening at each end which acts as a stop and lock for the button *A*. When *A* is in one of these openings the blade is concealed and when in the other it is exposed, the blade sliding in a rectangular hole in the handle. The curved blade shown in Fig. 1 is better for cutting quill than the straight blade shown in Fig. 3.

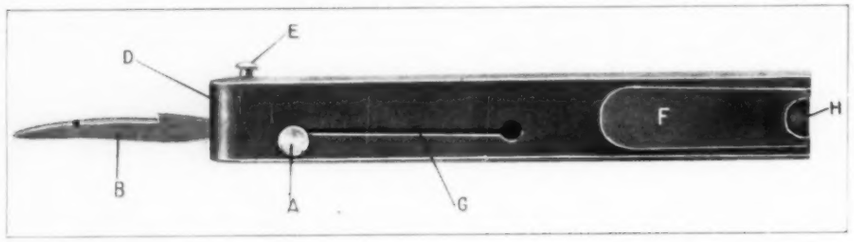


FIG. 1. PEN CUTTER WITH KNIFE EXTENDED

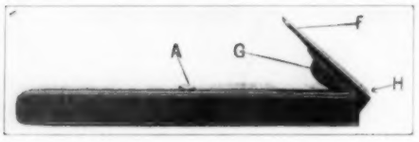


FIG. 2. PEN CUTTER WITH DIE RAISED FOR INSERTION OF THE QUILL

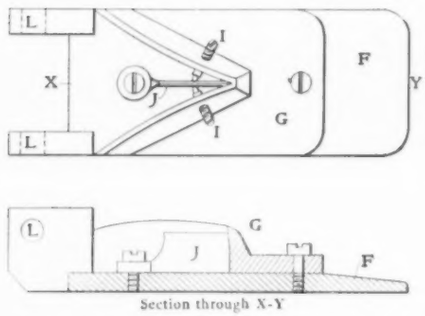


FIG. 4. DETAIL OF FEMALE CUTTING DIE

The die is mounted at the opposite end from the blade under the hinged plate *F* which is shown open in Fig. 2. The female shear *G* is at the top. This shear not only shapes the point but slits it. The slitting blade is shown at *J*, Fig. 3, and in the line cut, Fig. 4, also at *J*. It is secured to the die plate *G* by a screw and is adjusted between the sides of the female die by the two adjusting screws *I*. The quill *M*, Fig. 5, is first prepared by cutting a chip off the side of the tip, as shown at *N*. It is then inserted in the die (through the opening *H*, Figs. 1 and 3,) as shown in Fig. 6, the cut portion *N* of the tip being upward. The hinged lever *F* carrying the female die *G* is then depressed shearing the point of the pen first and then slitting the end, a click being heard as the slitting is accomplished. The pen is then drawn out. If the user likes a sharp-pointed pen the job is finished but if a stub is required the point of the pen is inserted at *D*, Fig. 1, and the button *E* is depressed. The button *E* connects with a small spring-end shear which clips the sharp point off the pen. It is shown more clearly in Fig. 7. By repeated clipping the point can be made as broad as desired. Fig. 3 shows the cutter I bought in England. I was told by the storekeeper that it was about 75 years old. The one shown in Fig. 1 is that used by my mother. The die has, I suppose, never been sharpened and yet it will shear ordinary paper giving a sharp, clean cut.

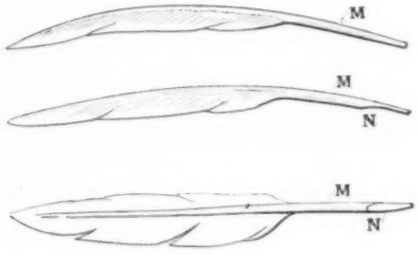


FIG. 5. THE PLAIN AND PREPARED QUILLS

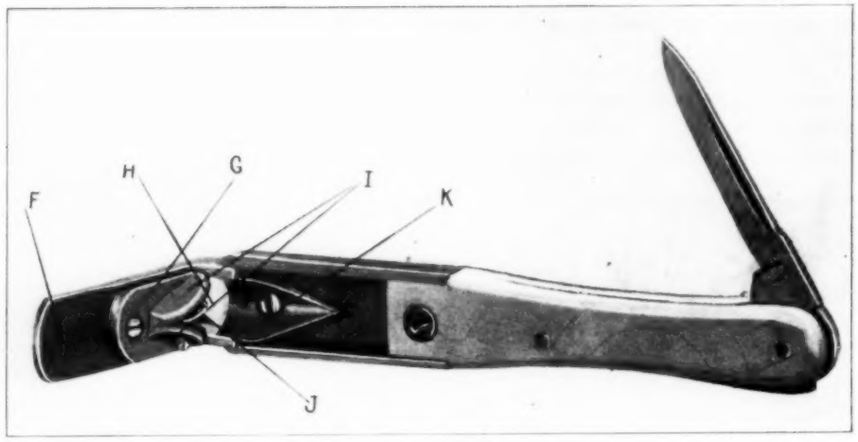


FIG. 3. SHOWING THE CUTTING DIES

New York. E. A. DIXIE.

Present Practice in Drafting-room Conventions

Articles of the type of that of Mr. Reid, at page 740, are of much greater value than appears on the surface, if instead of playing "follow my leader," and blindly falling in with the majority we look into them a little and see what has influenced the decision of that majority. There is some need of uniformity in many of the things about which Mr. Reid inquired, especially in the case of shops which send out or take in work. In a shop where work is done to outside drawings, draftsmen and foremen are apt to become hypercritical, mainly on the ground that if they do not criticize these outside drawings first the superintendent is likely to criticize them. All comparisons being odious, it is to their advantage to direct the odium where it will do them the least harm. If, however, a man will be really fair minded and spend only a trifle of time he can read almost any drawing with certainty.

Such questions as the style of center lines, whether or not red ink is used for dimensions, etc., really have a negligible effect on the intrinsic value of a drawing. In the same class belong the questions relating to the side of the tracing cloth to use, whether or not to use shade lines, what style of lettering, border lines and sizes of sheets, etc. On the other hand, some of these things together with the relative value of tracing cloth and bond paper are matters of expense, and an apparent saving can be made by the use of judgment. Often, however, the individual temperament will be such as to make it more expensive to use the cheaper paper, or the cheaper method. The few cents' cost of tracing cloth may be but a very small percentage of the total cost of a drawing, and the draftsman who is compelled to use bond paper against his preference may easily use up time that will run into dollars as compared with the results he would obtain if he was allowed to use his own judgment.

Again, there are a number of these questions that do affect the usability of drawings. For example, the varying ways that finish is indicated. Eight different ways are suggested, none of which can be considered beyond improvement.

Cross-hatching

The use of standard symbolic lines seems to have a trifle the best of the voting, though I doubt if all of the users of these sections are willing to depend entirely on them for denoting the material wanted. If there is a real standard, and if large cards or charts showing what those standards are could be supplied to hang in the shops then there would be a decided advantage in agreeing to use the standards; of course, provided the work was of such a nature that sections could be freely used without undue effort on the draftsman's part.

Representation of Screw Threads

Thank goodness 94 firms use the standard conventional thread, which indicates whether the thread is right- or left-hand. Why anyone should use the lazy-man's method, shown in Fig. 9 or Fig. 10, I do not know. In an assembly drawing, or anywhere else, it is apt to lead to confusion, unless workmen are specially trained to follow it. The conventional method is understood the world over, is not at all difficult to draw, and dispels every doubt as to what is wanted, particularly if in case the thread wanted is U. S. S., it is marked so. I think that a thread should be marked on a detail drawing either U. S. S., or U. S. S. and pitch, or pitch alone. The second indicates the standard form of thread, but a special pitch and the last indicating V-thread. Of course if an Acme thread is wanted, or any other than U. S. S. or V, it should be completely specified.

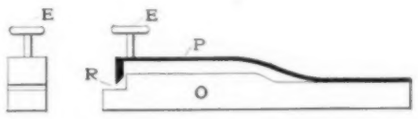


FIG. 7. THE POINT CLIPPER

Feet and Inches

It is not stated that the people who use 2′-4″ also use 2′-0″. If they do and can persuade everybody else to do the same it will be a great boon to draftsmen. If they use 2′ and a fly comes along and sits down just right, leaving it 2″, there are cases where it might cause confusion; especially in those cases where the head draftsman thinks that every inquiry is a criticism.

Bill of Material

Strictly speaking, it should make no marked difference whether there is a bill of material on each drawing or not, so long as there is a list somewhere available. I like a separate blueprinted sheet giving the names and pattern numbers of all detailed parts, together with the material, number wanted, and number of drawing on which the detail drawing may be found. It is also convenient to have on these lists the size and length of bar stock for all steel parts, so that the necessary stock can all be gotten in without looking up the drawings. The same applies to all stock parts such as bolts, nuts, etc. On detail drawings near each piece I like to have all of the above information. What sense there is in grouping all of it in one corner of a sheet, when it can so easily be used to fill in the spaces between drawings I do not see. It certainly is no easier to do nor easier to work from even if it does give a clearer appearing sheet. If the lettering is done with 1/16- to 3/32-inch letters the sheet will look neat. It is just as easy to make the small letters as the larger ones if one is used to it.

With this arrangement the foreman who has to see to his supplies of material has only to handle the small bill of material. The workman has to pay attention only to one drawing with its attendant notes. If the foreman wants to cut up a drawing, or rather blueprint, so that each workman can have a part to work from, each part is complete in itself. I know this is rank heresy, but on the other hand, if some of the managers of some of the most uptodate shops knew what was going on under their noses they would be rather surprised.

Changes in Drawings

Apparently the most vexing question of all is regarding changes in drawings. To make a new tracing for the sake of changing one dimension seems a needless

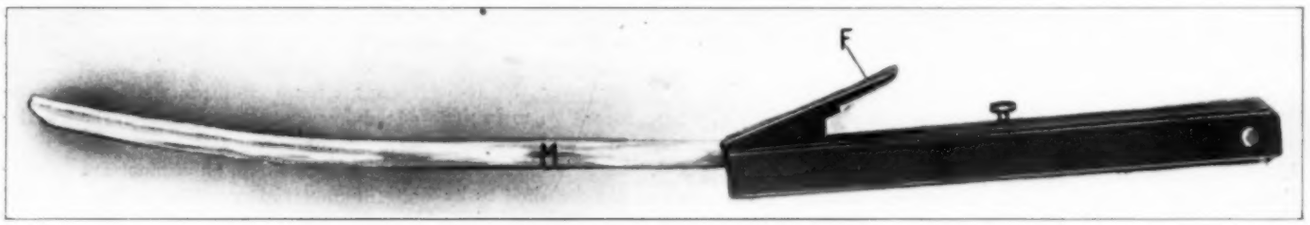


FIG. 6. THE QUILL IN POSITION IN THE DIE READY FOR CUTTING

waste. To have two dimensions on the same drawing for the same thing is apt to be disastrous, either through stupidity or thoughtlessness; even if it is indicated that only one should be followed.

To change a tracing without preserving some sort of a print is burning one's bridges behind. The ordinary blueprint is poorly adapted to use as a record, as it cannot be used to make other prints, except by photographing. Moreover, if a repair job comes in needing the use of the old print it is easy for it to stay in the shop, and not only be lost, but to pop up at an inopportune moment and be used to make some parts by that must later be scrapped. It is necessary to any system, though usually neglected, that all blueprints should be accounted for, otherwise they will be coming out of hiding places at equally undesirable times. If a tracing is used to print a negative from on some of the bromide papers, then it can safely be altered, all blueprints in the shop called in and new prints for repair jobs made from the negative.

PERSONAL PREFERENCES

So much for the essentials, now for some of the personal preferences: The old question of the glossy vs. the dull side of the tracing cloth seems to be settling itself with a vote of 66 to 32 in favor of the dull side. I believe this to be a matter in which the whim of the draftsman plays more part than anything else. The most plausible reasons in favor of the dull side seem to relate to the checking of drawings, since no clearly visible check mark can be placed on a drawing made on the glossy side that can be readily erased. The use of bond paper, which was on the increase 15 years ago, has now dropped back, probably due to the advent of the electric blueprint machines. They require six to eight times as long to print through a substantial bond paper as through a tracing cloth. This costs both for current and time. In sun printing it merely costs a few extra printing frames.

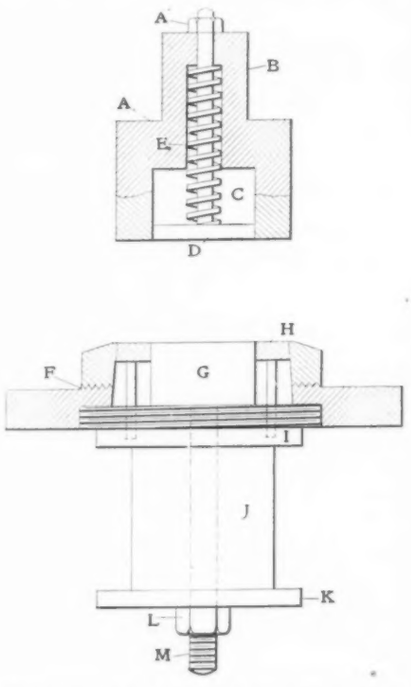
Fifteen years ago mechanical lettering would have polled a larger vote, and there would have been a large vote in favor of letting the individual draftsman design his own titles. Lately it has been discovered that a title is not an ornament, but an index giving certain information which is needed on every drawing. A few years ago I compared titles and border lines to collars and cuffs, saying that for use where one would not wear the latter the formal title and border lines could as well be omitted, reserving them for drawings made to show; that is, such drawings as might be taken out by salesmen to use in working up trades or such as might be shown to directors, etc., of the company. I still believe this to be correct philosophy, but I notice that by far the larger part of the shops use a border line and title.

Springfield, Mass. ENTROPY.

Blanking and Drawing Shells

Referring to the articles on blanking and drawing shells at one stroke in a single-acting power press by W. J. Murphy on page 346, and M. L. Marston on page 536, I cannot see clearly how either of these arrangements can work satisfactorily. How does W. J. M. get over the difficulty of buckling or wrinkling, which is bound to exist, unless the punch recess fits the tool post *D* (plus the thickness all around of the metal used) very tightly, and this could not be done when working on printed or similar work, as the printing, etc., would be drawn or scraped off. Then again, suppose a shell "sticks up" in the punch *C*, what method has W. J. M. got for ejecting it?

In the article by M. L. Marston, I note that he partly gets over the difficulties,



BLANKING AND DRAWING AT ONE STROKE

but if the shell is drawn over the tool post or plug *F*, where does it go to in the punch *A*? Referring to the illustration shown on page 536, there is no recess shown in the punch *A* for the shell to be drawn into, as the punch *A* descends into the die *C* and over the plug *F*. Then again, suppose the recess is in the punch *A*, as the shell is ejected from the bottom die, the recess shown at the top of the ring *D* and plug *F* would stop the shells from falling clear of the die, and each shell would have to be lifted out instead of sliding off the die. As I am frequently making dies for this particular class of work, I think the sketch and description herewith would be helpful.

Referring to the illustration inclosed, this is the general method of making dies for this kind of work. Any other design can easily be made, but following the same principle, *A* is the punch which is made by welding a steel ring onto iron. *B* is the shank which fits into the upper slide of the press. *C* is the recess into which the shells are drawn. *D* is the ejector which works up and down the recess *C*. *E* is a special spring which gives motion to the ejector *D*. *F* is the bottom die which is made by securing or welding a steel ring onto an iron plate. *G* is the plug (which screws into the bottom die *F*) upon which the shells are formed. *H* is the steel-pressure ring which fits and slides up and down the plug *G*. *I* is the cast-iron plate which carries the pressure pins. *J* is a rubber or spring buffer. *K* is a cast-iron washer. *L* is an adjusting nut. *M* is the spindle.

The tools are preferably set up in an inclined press so that, as the shells are ejected they fall by their own gravity into the receiving box. Stamping, embossing, or recessing can also be done in the bottom of the shell by making the plug *G* and ejector *O* to whatever shape may be required. Any further information I shall be pleased to give if required.

Swansea, Wales. A. WHITBY.

Machining Ball Bearings

I am interested in Ralph W. Davis' article "Saving Material in Turret Work," on page 901, as I helped to throw away a few dollars of other people's money along the same lines before getting down to business. If annular ball bearings are to be manufactured commercially of high-carbon or special-alloy steel, as is the best practice, it is necessary to forget all one knows about automatic or hand turret lathes, forming tools, multiple-cutting edge tools and all the other methods of cheaply working mild steel from the bar.

Such methods can be made to work only by an expenditure for time, tools, and appliances which take the business out of the commercial class into that of the laboratory. If any ball-bearing manufacturers are meeting with moderate success using such machines and tools, they must be machining a quality of steel far from the best for the purpose.

It is, of course, highly important to save all the material possible as the material should represent closely half the value of the finished product. The practice of the leading European makers of annular bearings and also of two American makers is to cut their bar stock up into disks in a heavy, rigid, cutting-off machine using a front and back tool; no cold saw can give the same results, as thousands have been fruitlessly spent in that direction. The disks are then taken to a simple lathe equipped with a universal chuck and a single trepanning tool which projects from its holder very slightly over half the thickness of the disk to be cut. This tool is fed in half way, the disk reversed and then fed in the other half, removing the

center intact, to be used for a smaller piece.

This operation can be quickly performed, and not the least factor controling the time is the fact that a general smashup of the tool is not a seriously expensive matter. This method has been found economical even when the core removed is too small to use for another piece, as it is quicker than drilling and the tools used are much cheaper. The rings produced by this trepanning operation are then finished in simple lathes, each lathe doing at most two operations.

This practice, when contrasted with the former up to the minute tools, was found to divide the average cost per piece by four with a very large saving in capital investment.

New York. A. L. SPARKS.

Water Nozzles on Grinding Machines

I read with much interest the two articles on the above subject by Messrs. Bath and Norton for the very good reason that I have been up against the soda-water nuisance for some time.

We are running some of our wheels at 7500 feet per minute and I find that at that speed and with ordinary appliances nothing but force and plenty of it will place water at the desired point, and then, of course, much of it finds its way to the floor.

So I made the nozzle shown in Fig. 1 which gives a wide, flat stream. Under working conditions, unless the water is flowing at high velocity (when it has no shape at all) it flows as shown in sketch.

The idea for the second attempt, Fig. 2, was taken from a domestic kettle. The results with this were about equal to the first. Fig. 3 shows the arrangement we

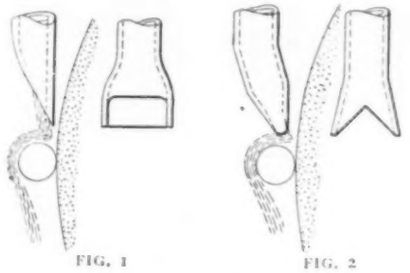


FIG. 1 FIG. 2

ACTION OF WATER ON WHEEL

are using now, which is fitted with draft screen *A*.

Instead of the water being blown away from the work the wheel grinds in a flood of water which covers the face, and behaves quite orderly. I have endeavored to sketch the streams of water as they appear in a general way, but it is difficult to get the exact shape.

I have not seen such a nozzle as Mr. Bath describes but it would be interesting to know how it behaves with a wheel running at 7500 ft. per minute. Incidentally there are one or two points which may be of interest to someone.

Diamonds are usually mounted in a holder which is in line with a radius of the wheel. I have found this to be bad practice as flats are caused by the high speed and it is necessary to reset the diamond. If the holder is set as shown in Fig. 4, pointing below the center of wheel, a new

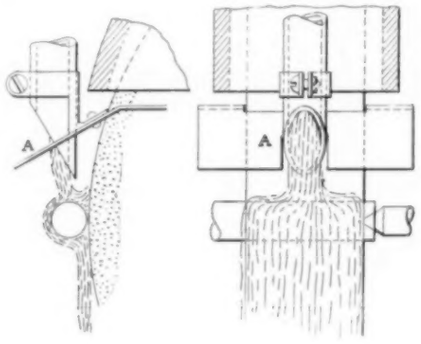


FIG. 3. NOZZLE WITH WIND SHIELD

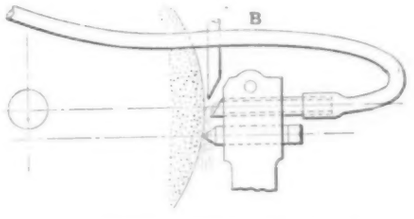


FIG. 4. TRUING WHEELS WITH DIAMOND BELOW CENTER

edge can be obtained on the diamond by revolving the holder in its socket.

In truing up wide wheels the ordinary supply of water is not suitable for keeping the diamond cool as it is usually conducted through a pipe which is fastened to the splash guard and does not follow the diamond. Fig. 4 also shows a way out of this difficulty; a rubber tube *B* is connected to the ordinary supply pipe and water is fed onto the wheel, through this, immediately above the diamond, thus keeping that important tool always in a stream of water.

Glasgow. SWAN FIELD.

Accurate Planing to Avoid Unnecessary Scraping

At page 683 L. F. C. George ventures a few remarks on accurate planing and, as an old planer hand I may be able to help him out. Apparently his principal trouble is caused by deflection owing to the elasticity of the castings handled. Taking the two castings, one of which has been exposed outside in the yard to all kinds of weather, say, for six months and the other fresh from the foundry a couple of days old, which has cooled down to the atmospheric temperature meanwhile, and set up these castings, plane them in exactly the same manner, allowing for deflection and deformation of the casting caused by machining and we obtain practically the same results.

Mr. George speaks of pulling the castings down 1/32 inch at both ends when planing to get them reasonably straight, whereas they would come out 1/32 inch hollow or low in the center when planed in their natural position; this would have the opposite effect to that desired, seeing that if the castings were planed and were 1/32 inch hollow in the center, then the ends allowed to spring up the 1/32 inch pulled down when setting, making the defect 1/16 inch altogether, so that it appears this should read *packed up* at both ends 1/32 inch. This would neutralize the defect of 1/32 inch already existing, probably in the machine, the result being a casting reasonably straight.

In speaking of the natural position of a casting, it is assumed that Mr. George means the position of the casting when lying, say on the surface slab and supported at those points on which it will finally rest.

With the casting roughed out entirely so that practically no more physical deformation will take place as the result of machining, and before the finishing planing it should be tried on the surface slab for deflection. This in some castings is considerable and the amount may be ascertained in the following manner: First support entire weight of casting at the two extremes as in Fig. 1, which will cause the center of the casting to drop if it is not perfectly rigid in itself. Strike a line with the surface-gage at the ends and along the center at the same hight, then lift up the center as in Fig. 2 until the casting just touches the end supports, all the weight being relieved. Test with the surface-gage to see that the ends have not been raised any, then strike a second line at the center. In some cases with a casting 20 feet long the two center lines will be 0.25 inch apart so that it may be said that the deflection is 0.125 inch. This is only an approximation and while it is good enough for a great many purposes it is

MEASUREMENTS DESIRED TO SHOW SPRING

not good enough for precision work, for if the casting is turned over and the operation repeated the result in many cases will be different and yet each time the casting is in a natural position.

Take for example a lathe bed 20 feet long, which is not rigid enough to prevent deflection when supported at the center or the two extremities. Having performed all operations likely to cause any physical deformation or change of structure, pro-

ceed as follows: First find approximately the amount of deflection, set up the bed on the surface slab, supporting it at the same points as it will rest on in its *final* position. Then fix the five pieces, Fig. 3, to a machined face if possible, the faces *C* being parallel to the surface slab, testing them for accuracy with a dial indicator, or if this is not available, with the straight-edge and surface-gage. The next thing is to see that the bed is in alinement, which can be done by fixing the pieces, Fig. 4, at right angles to the base setting them in the same manner. If a right-angled surface slab of sufficient dimensions is not available, the faces *D* can be set within very close limits with a straight-edge. The bed should now be set on the planer table and supported in the same way, with any additional supports which may be necessary to prevent deflection of the planer table when overhanging its own bed. The pieces fixed to the bed to be planed are now set in line from the tool box with the indicator or the taper gage, Fig. 5, slipped under a parting or other square-nosed tool as shown. The readings being 0.002 inch it will be seen that by this means very good results may be obtained. When set in this manner it will be found that even with a machine which has small defects in the way of alinement a casting which is flexible may be planed nearly as true as the surface-slab on which it was set before planing; in any case the troubles caused by flexibility will be eliminated if the necessary care is exercised in setting it.

In the bolting down of work on the planer Mr. George's practice varies considerably from my own experience. Certainly many planer tables can be sprung by careless bolting down, but that should not prevent the planer hand from securing the work as rigidly as possible to the table. First stop the work so that it cannot move in a lateral direction even without the bolts, then using as few bolts as possible pull the casting down tightly without springing, making the work and table resemble one piece, care being taken to have the bolts close to the work and to extend the base of the packing pieces so as to touch the bolt and cover as much of the surface of the table as can be spared.

When bolting down, shims of the folding-wedge type, Fig. 6, should be used, so that if the dial indicator or taper gage show that the work is being sprung down, the bolt of the folding wedge can be tightened and the work raised to its normal position.

GEORGE BILHAM.

Woolwich, England.

A French Hydraulic Riveter

These are hydraulic riveters of the self-contained type as the pump forms part of the machine itself and no accumulator is used. Figs. 1 and 2 give a good idea of the general appearance of these machines and show different methods of suspension according to the work for which they are to be used.

The details of construction can be readily followed by referring to Fig. 3, in which the frame *A* carries a cylinder *B*, formed at its outer end and containing the piston or ram *C*. The handle *T* operates the controller *S* for motor *I*, and on starting the motor the bevel pinion on the motor shaft drives the large bevel wheel *N*, which acts as a nut around the screw *M*, and forces it, together with the plunger *J* down into the hydraulic or pump cylinder *K*. From here the water or oil is conveyed through pipe *L* to the reservoir *D*, through a cock on the inside controlled by handle *G*, and is admitted to the top of ram *C*. As it is forced downward to drive the rivet between the dies shown, it carries with it the recoil rod *E*, which is surrounded by a heavy spring, so that, as soon as the pressure is released, this

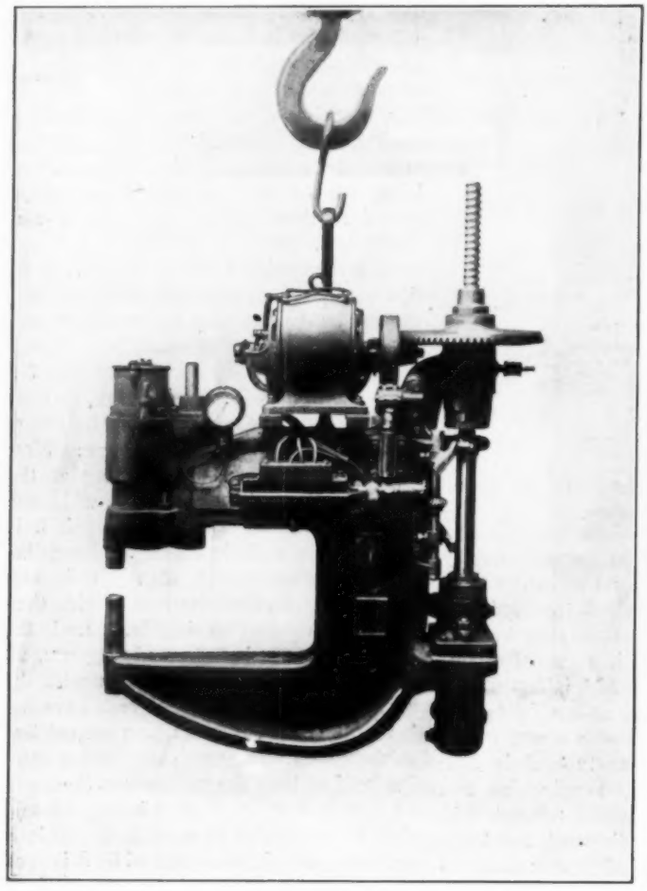


FIG. 1. ELECTRO-HYDRAULIC RIVETER

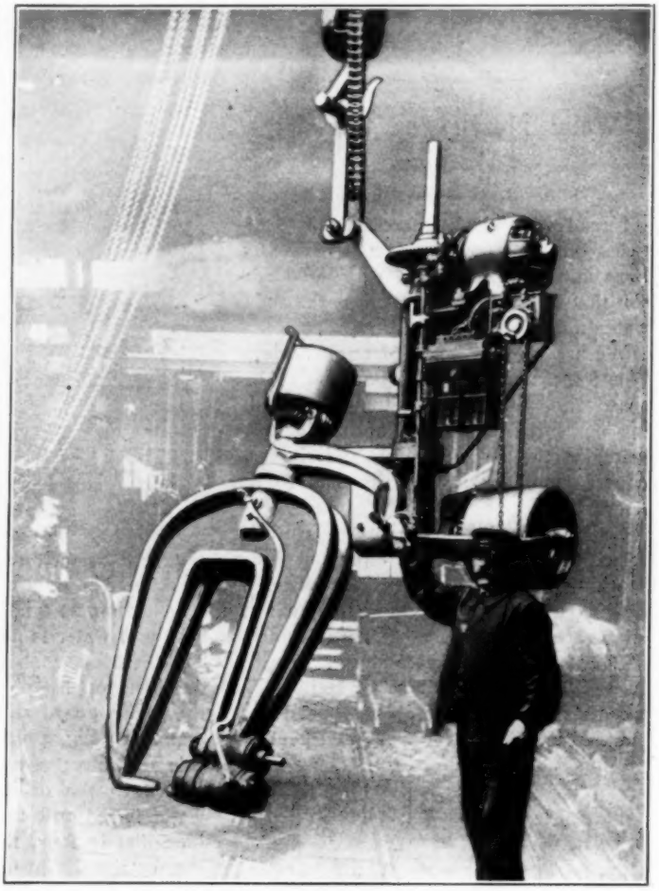


FIG. 2. ANOTHER FORM OF THE SAME RIVETER

will carry the ram C back to its normal position.

When the controlling handle T is thrown down to start the motor it releases the brake U, and also turns the shaft R on which is mounted the two adjustable cams $Q\,Q$, throwing them into position to engage the stop P on the plunger J. As soon as the plunger, and with it the ram C, have been forced down to the predetermined distance, the roller P engages the lower cam and automatically throws the handle T back to normal position and applies the brake. To return the ram C the controlling handle is raised, which

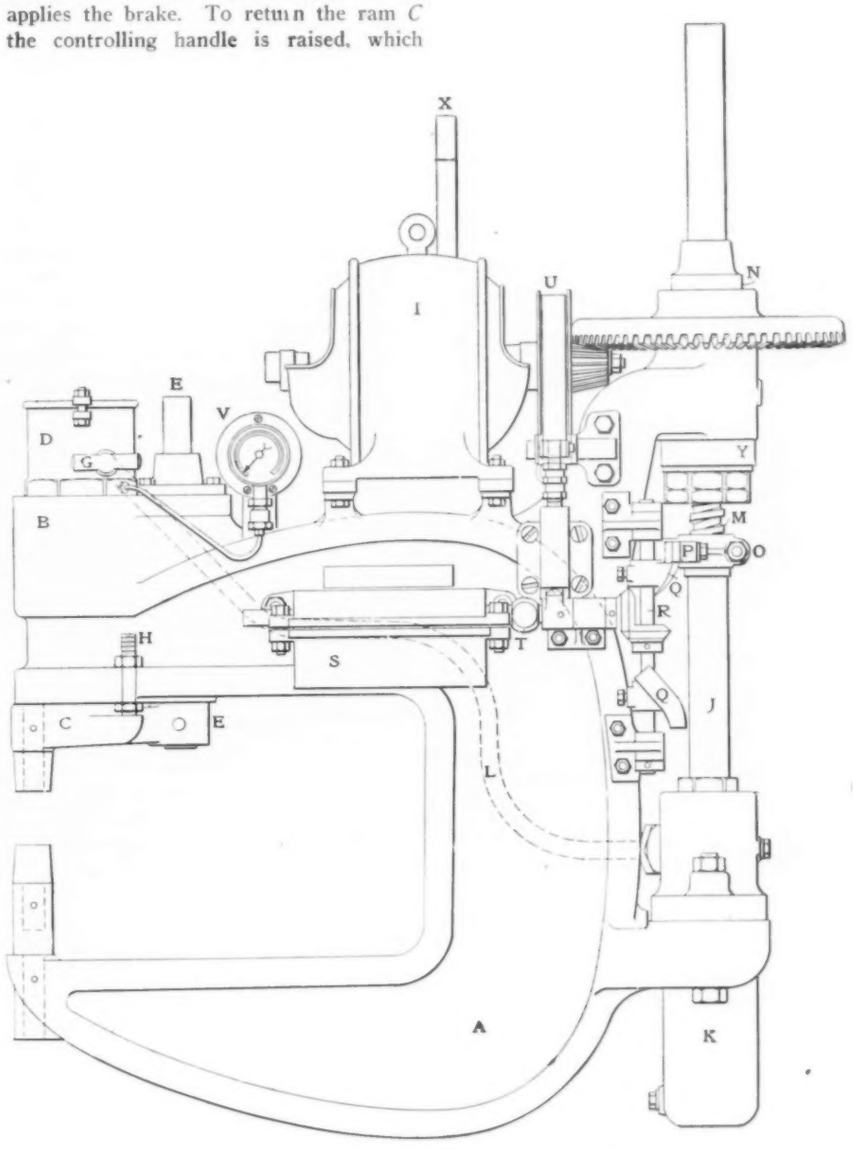


FIG. 3. DETAILS OF THE ELECTRO-HYDRAULIC RIVETER

again releases the brake and reverses the motor, withdrawing the plunger J from the pump cylinder K and allowing the water to flow back through L as the ram is drawn up by the spring surrounding E. The pressure at all times is shown on gage V, while X is a suspension yoke for the riveting frame, as seen in Fig. 1. A ball-bearing thrust collar Y reduces the friction on the geared nut N. These riveters are made by A. Piat & Sons, Paris, France.

Action Against Trade Mark Copying in Japan

In view of the numerous complaints against the Japanese as wholesale copyists, the following from the *Japan Advertiser*, of Yokohama, will prove of interest:

The following is the translation of a circular letter addressed by the Vice-Minister of Agriculture and Commerce to prefectural governors and chairmen of chambers and commerce:

"The sound industrial development of a nation can only be brought about by the honest and assiduous application of the people to their occupations. In the present condition of our country, it is urgently necessary to stimulate the people to prize commercial morality and to do business with unvaried diligence and attention. At this juncture His Majesty the Emperor has given an Imperial Rescript inculcating honesty and encouraging frugality and diligence. This Rescript, deep and far-reaching in its import, must be carefully remembered and strictly adhered to not only by business men, but by the whole nation. On casting a glance upon our industrial and commercial circles, however, it will be seen that with the enlargement of the sphere of our business activities, vices attendant to competition have begun to make appearance. A tendency is noticeable among merchants of attempting to engross business excluding others, and among manufacturers of producing imitated articles and adulterated goods, sacrificing without scruple the interests of others to their own small and transitory gains. Even the rights of inventions, trade-marks and other industrial properties are infringed, and cases of imitation and plagiarism are often brought to our notice. Such phenomena are indeed very discouraging for the future of our industrial development. Moreover, cases of unauthorized appropriation of foreign trademarks, commercial names, etc., are reported now and then, and petitions for remedy have been received from the aggrieved parties. It is true that among these complaints set forth by foreigners, there are some which cannot be said to be well founded from the legal point of view; but any conduct on the part of our business men that may seem dishonest or fraudulent, will bring grave results not only by discrediting our commerce and industry, but also by staining our national honor. The accompanying specimens are a few examples of imitated trade-marks, from which an idea may be formed of the existing state of things. Of course applications for registration of such imitated trade-marks are subjected to strict examination, and anything considered by the authorities as calculated to deceive the public are rejected. But at this propitious occasion of the promulgation of the Imperial Rescript, it is considered highly desirable that our business men be persuaded to come into unison and warn one another to use only safe means in the pursuit of wealth and promotion of industry, always bearing in mind that the first principle of business is to acquire credit by honesty and diligence, and thus to make an epoch of improved morality in the history of our commercial and industrial progress. With this object in view, it is requested that you will explain to all concerned and make them understand that the rights of inventions, designs and trade-marks must be respected and that unfair competition brings nothing but injurious results, at the same time warning them against the bad practice of turning out debased goods and the shortsighted policy of trying to sell merchandise rashly irrespective of price. It is also requested that you will instruct all associations of various branches of trades to take proper measures to stop dishonest dealings of the members of their respective associations."

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

JOHN A. HILL, Pres. and Treas. ROBERT MCKEAN, Sec'y.

505 Pearl Street, New York.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

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Subscription price $4 per year, postage prepaid, to any post office in United States, United States possessions and Mexico. $5.50 to Canada. $7 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

Hill Publishing Co., Ltd., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Business Telegraph Code.

CIRCULATION STATEMENT

During 1908 *we printed and circulated* 1,205,750 *copies of the* AMERICAN MACHINIST. *Our circulation for December,* 1908, *was (weekly, monthly and European)* 108,250.

January 7	34,750
January 14	19,500
January 21	19,500

This paper reaches 34,750 *separate readers each month and* 19,500 *each week.*

None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

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The index to Part 2 of Volume 31 will be sent to any of our readers who send a postal-card request with name and mailing address.

The Engineer and the Public

Morris L. Cooke injected a new line of thought into the recent meeting of the American Society of Mechanical Engineers by urging upon the members a sense of their responsibility to the public. The thought advanced by President Hadley, of Yale University, in his address at the dedication of the Engineering Societies' building in May of 1907 that: "There are three professions today which do not regard themselves as servants, but as masters—the financier, the journalist and the politician. If the engineer and the lawyer accept positions as servants, simply putting their technical knowledge at the disposal of the merchant, journalist or politician who will pay the highest price for it, it is not simply a question of inferiority, but of dereliction of public duty," was taken up and expanded.

No one who gives the matter thought will be likely to contest the assertion that in the manifold activities of the society and of the profession the general public as such has been almost ignored. Among the announced committees of the society not one has a title indicating a function broader than the conservation of the interests of engineering and of the engineering profession. Among the thousand and more papers listed in the last published index to the *Transactions* it is difficult to find a single title which indicates that the author was addressing anyone beyond his professional audience. Inquiry among the lay public will show that while the society is given full credit for its professional strength, absolutely no credit is given to it for interest in public matters.

Mr. Cooke suggested (and the suggestion was adopted by the society) the appointment of a Committee on Relations with the Public, which will seek to give publicity to the fact that the American Society of Mechanical Engineers stands ready to offer disinterested advice through its council to Government officials, municipal, State and national, similar to the relations now existing between the Federal Congress and the National Academy of Sciences; to establish such relations with the lay press as will make its advice and help sought when engineering matters are up for public discussion; to provide for courses of lectures for the general public, to be given under the supervision of the committee in the Engineering Societies' building. Two ideal lectures of this kind were given during the recent meeting; one by Professor Brashear upon "Photographing the Stars," and the other by Lieut. Frank P. Lahm, U. S. A., upon "Aëronautics."

As an instance in which the mechanical engineer could have been of immense service to the public, an investigation of the fire risk in theaters, conducted by John R. Freeman, a past president of the society, following upon the Iroquois theater fire at Chicago, is cited. The investigation was made at the expense of a public-spirited man "not for the purpose of fixing the blame, but to help us find out how such fearful disasters can be prevented." Mr. Freeman's report contains specific recommendations as to theater construction and the prevention of fires in buildings of this class, which were so logical and relatively so simple that if they could have been made of general public knowledge theater owners and proprietors must almost inevitably have been forced by public opinion to their observance, if not even impelled thereto of their own accord. And yet all the publicity that was given to this work was through the distribution of copies printed at private expense to theater proprietors and the officials of a few municipalities.

Just as members of the medical profession have learned to treat disease broadly, to work together for prevention, suppression and eradication, rather than to potter individually with specific cases and to guard successful prescriptions and treatment as professional secrets and private property, so the engineer must arise to a broad conception and collective treatment of the great problems of engineering with which the age is replete.

Up to a comparatively recent date, the professional knowledge of an engineer was his own property, and he felt that in imparting any of this knowledge to another engineer he was doing himself a decided injury. Discussions between engineers were carried on mainly with the idea of doing each other harm rather than good. The large number of engineering societies, with the fundamental object of the free exchange of engineering data between their members, shows how thoroughly engineers have learned that the general policy of giving freely of their knowledge to their fellow practitioners increases rather than diminishes their effectiveness.

In proposing the appointment of this new standing committee Mr. Cooke suggests only the extension of this coöperation to include the public. There is good reason to believe that engineers have as much to gain from coöperation with the public as they have undoubtedly gained from coöperation with each other. The time may come when the increasing number of papers of interest alike to the engineer and the layman will suggest the necessity for a Section on Public Matters. It is no longer possible for either a pro-

fession or a craft to corner information and hold it for its own use. Broadly speaking, those who seek information in any field can obtain it, or at least enough to answer their immediate purposes. This danger would in itself constitute a sufficient reason for the engineer to take the public into his confidence. For, after all, it is public opinion and not the dictum of the engineering fraternity which finally decides the large questions of engineering practice. Only by educating the public to understand and appreciate the work of the engineer can the public be made to demand the best that can be devised and executed by trained and skilful men.

The suggestion of Mr. Cooke and the action of the society are most timely and should bring about far-reaching beneficent results. Two of these results will be a widened field of work for the engineer due to increased public demands, and a truer appreciation of engineering work on the part of the public. The movement is, again, timely, for it is directly in line with the present trend toward a keener recognition of the responsibility of public service, that rests upon everyone; and engineers, as members of a great profession, should accept this responsibility as soon as it is recognized.

The January Meeting of the A. S. M. E.

The paper presented at the monthly meeting of the American Society of Mechanical Engineers held Tuesday evening, January 12, was by Carl G. Barth, on the subject of belting.

The theory of belting has been of slow growth and, until the experiments by Wilfred Lewis and J. Sellers Bancroft, made at the works of William Sellers & Co., and presented to the society in a paper read at its Chicago meeting of 1885, that theory was based upon a fundamental error—the assumption that the sum of the tensions in the two sides of a belt is constant. While these experiments demolished this error, it still lingers in mechanical textbooks, and it has remained for Mr. Barth to construct a correct theory based on these and many other experiments.

The paper is a masterly piece of analysis and one which has involved a fairly appalling amount of work. Despite its mathematical character it was received in the most flattering manner. Mr. Barth captivated his audience at the start and held its attention for over an hour while the discussion continued until after 11 o'clock, and was in the highest degree complimentary. In his powers of mathematical analysis combined with the temperament and viewpoint of a practical constructor, Mr. Barth is probably without an equal in this country.

New Publications

PERSPECTIVE SKETCHING FROM WORKING DRAWINGS. By Frank E. Mathewson. 80 5½x8½-inch pages, with 28 full-page plates. The Taylor Holden Company, Springfield, Mass. Price, $1.

This book is decidedly out of the ordinary as a textbook for drawing and commendably so. Its author appreciated the fact that many pupils, who could readily make working drawings or sketches, could not easily recognize the similar forms when embodied in more or less complicated working drawings. He therefore developed a series of exercises and problems in perspective sketching from working drawings without the use of models, and this series is the basis of this book. There is a very real advantage to anyone who possesses the power to translate working drawings into perspective sketches, for it thus gives him the ability to make clear the meaning of such drawings to persons who have difficulty in reading them. For the person himself it gives him the power to visualize the object from the mechanical drawing. Only a small amount of space is devoted to general principles and definitions of perspective drawing; the student is then started at work on perspective drawings of the common geometrical figures, developing them from working drawings. These exercises gradually increase in the amount of detail and complication until the student is finally led up to the making of perspective drawings of highly organized machine parts; see Plate 28, which is of a tool block with a tool post holding a diamond-point tool. The book should find a wide field outside of student courses; for the man in the shop, and anyone who has to deal with the interpretation of working drawings, will find it to his advantage to study its pages.

LOGARITHMS FOR BEGINNERS. By Charles N. Pickworth. 48 5x7¼-inch pages. D. Van Nostrand Company, New York City. Price, $1, net.

This little book treats of logarithms in more detail than is usually found in textbooks of algebra and trigonometry. It is intended to smooth out many of the difficulties met with by the beginner in grasping the fundamental principles of logarithmic calculations. Logarithms are defined clearly, the underlying rules are stated plainly, and numerous examples are shown employing logarithms and antilogarithms. The section devoted to a discussion of negative characteristics is especially valuable. While the use of cologarithms, or logarithms of reciprocals, is mentioned, it is not made as prominent a feature as the subject seems to warrant. As the process of addition is quicker and simpler for the average person than subtraction, the use of cologarithms is to be commended as a further step in the simplification of computations. The tables seem to be unduly abbreviated, for there are less than two pages devoted to four-figure logarithms and only two for anti-logarithms. Logarithms are not used as much as they deserve to be in engineering computations, largely from the fact that many persons who could use them to advantage are lacking in a thorough understanding of the principles involved and of the results that can be obtained. To such persons, as well as to students, the book is to be recommended.

The Worcester Mechanical and Electrical Exposition

Official announcement is made of a mechanical and electrical exposition to be held in Mechanics' hall and Washburn hall, Worcester, Mass., March 27 to April 3, inclusive. The exposition is to be under the auspices of the Worcester County Mechanics' Association, the management being in the hands of H. F. Campbell, who has established headquarters at Room 6, Mechanics' Hall building.

Personals *

Augustus Brown, for the past six years superintendent of the Monarch Emery and Corundum Wheel Company, is now associated with the American Emery Wheel Works, Providence, R. I., as assistant superintendent.

C. F. MacGill, superintendent of works of the New York Air Brake Company, recently resigned to accept the position of factory manager of the Lyon Metallic Manufacturing Company, Aurora, Ill.

George H. Baush has resigned his position with Hill, Clarke & Co., to take effect February 1, when he will become sales manager of the Fay Machine Tool Company, Philadelphia, Penn.

*Items for this column are solicited.

Joseph Wharton

Joseph Wharton, prominently connected with the iron and allied industries for more than forty years died at his home in Philadelphia, Penn., in which place he was born 83 years ago.

Mr. Wharton established and was one of the principal owners of the Bethlehem Iron Company, of which the Bethlehem Steel Company today is a development. He bears the distinction of having established the first nickel refining works in this country.

He was a man greatly and actively interested in educational advancement, a contributor of many articles on industrial, financial and scientific subjects, and was a past president of the American Iron and Steel Association.

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make it Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

A Substantial Screwdriver

Every mechanic knows the advantage of having a screwdriver with a handle that does not come loose or twist off when a heavy strain comes on it. This is drop-forged in one piece with the handle, a central web leaving room for wooden knife handles on each side, as shown. The end is solid so that it can be used as

A SUBSTANTIAL SCREWDRIVER

a hammer, if necessary, and the square shank allows a wrench to be used. They are also made with round shanks if desired. The maker is the Elmore Tool Manufacturing Company, Hartford, Conn.

A Self Contained Pneumatic Hammer

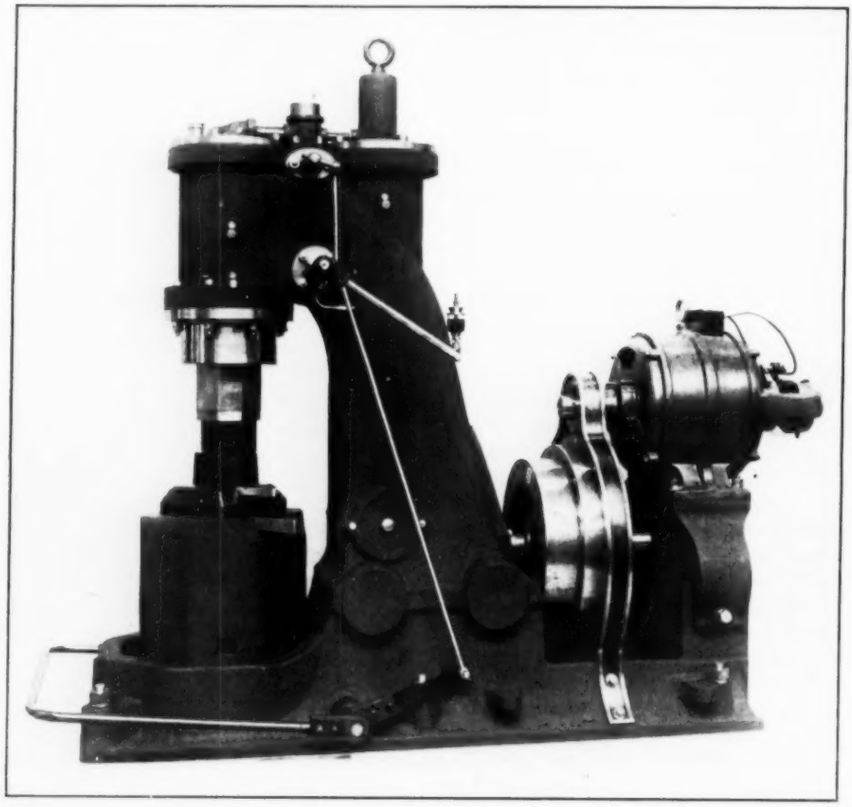
The Nazel Engineering and Machine Works, Philadelphia, Penn., are putting on the market the Beche pneumatic power hammer, having secured the sole American rights for manufacturing. It is patented in the United States and the principal foreign countries.

It is self-contained, as it compresses its own air as needed, and can be placed anywhere without regard to an air supply or piping of any kind.

The hammer frame consists of one piece which is bolted to bedplate, the anvil block being separate. The working parts consist of two cylinders, one in which the air-compressing piston operates, actuated by a connecting rod attached to crank shaft, which in turn revolves with each revolution of belt-driven pulley or motor-driven flywheel. In the other the ram or hammer head, sliding vertically on closely fitted guides, operates by means of compressed air and vacuum, influenced by piston in opposite cylinder.

The hammer is of closed construction, so that no foreign matter can reach the working parts. Fresh air is admitted at every stroke through a pipe leading outside, which prevents the hammer from becoming overheated. All movable parts and both cylinders are automatically lubricated. The hammer is easily operated, and by means of the air-regulating valves it is possible to hold the ram suspended at any hight and to instantly change the lightest blow to a heavy one; by the closing of valves the ram remains immovable in its highest position.

This hammer will be made in seven sizes, from 66- to 660-pound ram weights, and can be furnished for either belt or motor drive.



SELF CONTAINED PNEUMATIC HAMMER

The Stay-in Drill Socket

The positive driving of drills or the using up of those with broken tangs has led to several ingenious devices, the latest being the "stay-in" made by G. R. Lang Company, Meadville, Penn., and illustrated herewith. It consists of the usual drill socket which has a piece of drill rod let into it so that over one-half the rod is incased in the socket in order to hold it firmly and have it act as a solid key. With new drills it is best to mill a 90-degree slot in the shank, or a flat can be ground instead as shown in Fig. 2 if desired, which will

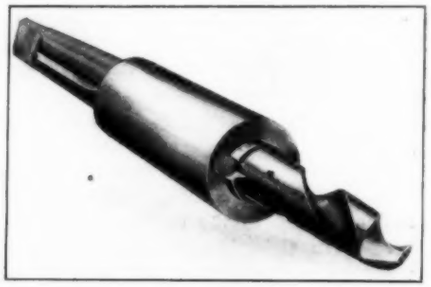


FIG. 1. THE STAY-IN DRILL SOCKET

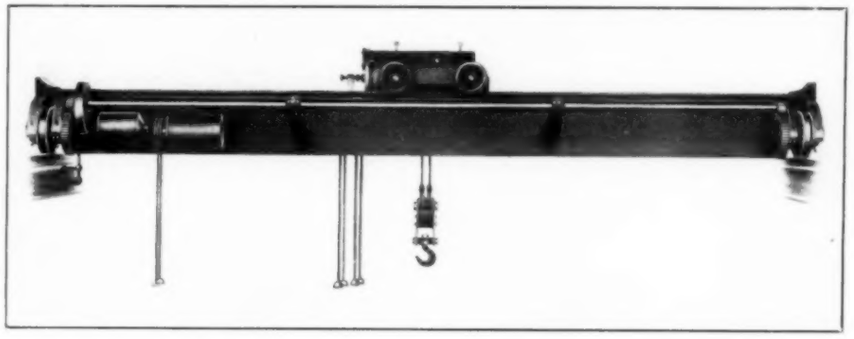
FIG. 2. DRILL SHANK GROUND FLAT

probably be considered good enough for drills with twisted or broken tangs.

This is also applied to the sockets themselves by fitting the drill-rod driving key into the drill spindle. This can be done very easily in any shop as the makers furnish a drilling jig so that the hole can be readily drilled with very little delay.

A Crane of Moderate Capacity

This has been designed for such shops as do not need the services of a crane man and is entirely controlled from the floor, no matter what the hight of the crane. It is from 1 to 5 tons capacity for spans of from 12 to 40 feet, and is made with one, two or three motors, as desired. The bridge is of the double-girder type and carries a trolley with an electric hoist having both mechanical and electric brakes, and an automatic limit stop for the block. The electric brake acts when current is cut off for any reason, while the other assists in holding the load and helps control the lowering.



CRANE CONTROLLED FROM THE FLOOR

All hoisting gearing is of the spur type, and is inclosed in an oil-tight case. The controllers have resistance enough to give a wide range of speeds so as to make it suitable for foundry or riveter work. It can be arranged with a cage, if desired, or to be controlled from a fixed pulpit on the floor. It is made by the Northern Engineering Works, Detroit, Mich.

An Induction Clutch for Planers and Other Reversing Machinery

In operation, this is very similar to an induction electric motor. Two steel castings *D* and *E* carry the exciting coil *F*, and when current flows through this as it is turned by the motor itself, the copper ring *B* is dragged after it by the attraction of the magnetic flux and the eddy currents set up in the copper. The movement of ring *B* turns the spider *A* and drives the planer or other machinery.

One of these clutches is provided for both forward and reverse motion, as shown at each end of the motor in Fig. 1, and the coil-carrying frames are driven by the motor itself while the spider *A* runs on the outside of the shaft and carries a gear keyed to it. One clutch, as the one at the left, gears direct to the driving shaft of the planer, while the other has an idler in the train to secure the reversal of the shaft when that is driving.

When current is switched into the left-hand clutch, the copper ring is attracted and drives the planer in the forward motion. Cutting the current out of this clutch and throwing it into the other, drags the other copper ring into action and reverses the planer through the other gearing. The relations between slip and torque are practically the same as in a motor and depend on the ring and the strength of current. The speed is less than the driving motor, due to slip, but there is no friction or wear except in the bearings. Any heat generated by eddy currents in the ring is dissipated by air thrown against it by the revolving poles, which act as blades in a fan. The ring is fastened by its outer edge, as shown, so as to allow full expansion from any heat that may be generated. As will be seen, the clutches are small as compared with the motor, weighing about one-seventh as much. They are made by the Wheeling Mold and Foundry Company, Wheeling, W. Va.

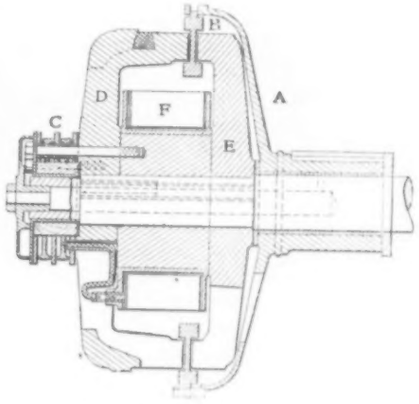


FIG. 2. SECTION OF INDUCTION CLUTCH

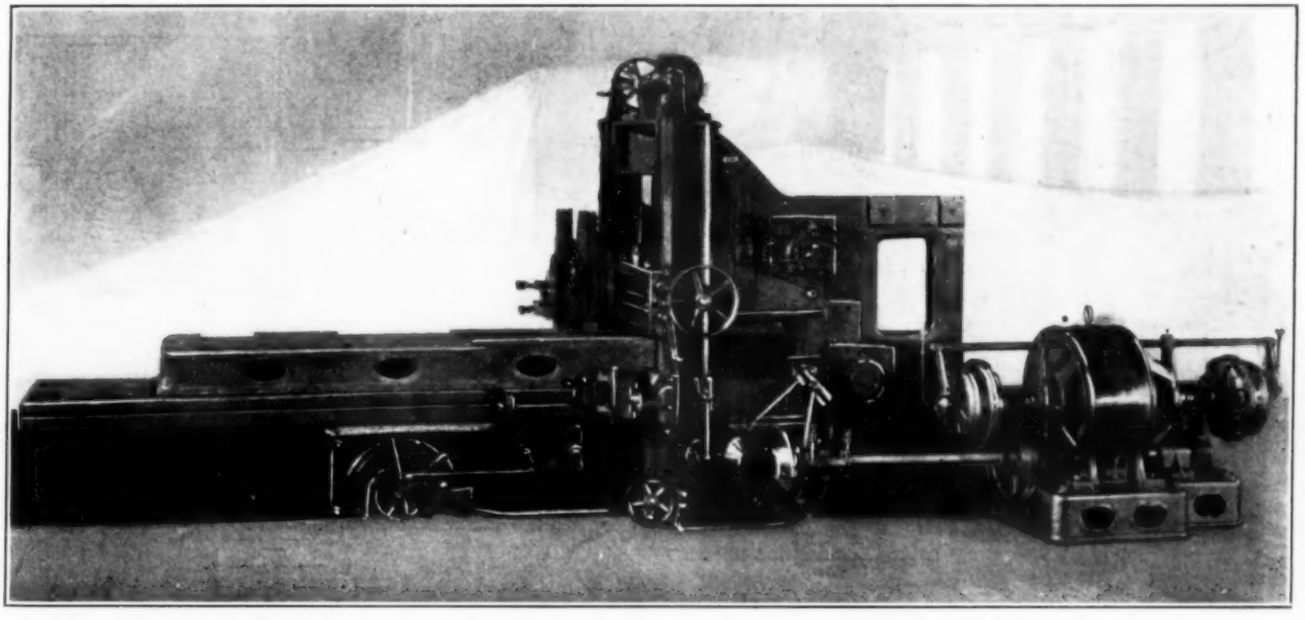


FIG. 1. PLANER WITH INDUCTION CLUTCH DRIVE

New Tool Room Grinder

This has been designed to make the grinding of hobbing cutters for gear hobbers, both accurate and easier than with the regular grinder. For this purpose the grinder head swivels both vertically and horizontally, which requires a special belt drive as seen in Figs. 2 and 3. This is accomplished by bringing the belt down from the driving pulley, under an idler, around the spindle pulley, back over the other idler and down to the lower pulley shown. Fig. 3 shows its action when the head is swiveled. This arrangement of a horizontal loop maintains a normal tension at all times and in all positions, the spindle pulley swiveling at the center of the two idlers, and the lower idler being of double width, allows it full play in all positions of the head, as the upper idler is journaled in a swiveling bracket. This combination avoids crowding the flanges, and as each idler is mounted on a hardened-steel spindle which runs in bronze-bushed bearings, the wear is easily taken care of.

Improvements have also been made in both longitudinal and cross-feeds, as shown in Figs. 4 to 8. All the feed works are mounted in the carriage. Pinion shaft 1 operates the platen by means of a clutch, shown in detail in Fig. 6. The clutch gear is driven by compound gears 2 and 3, one of which meshes with the worm 4, mounted on the reversing clutch

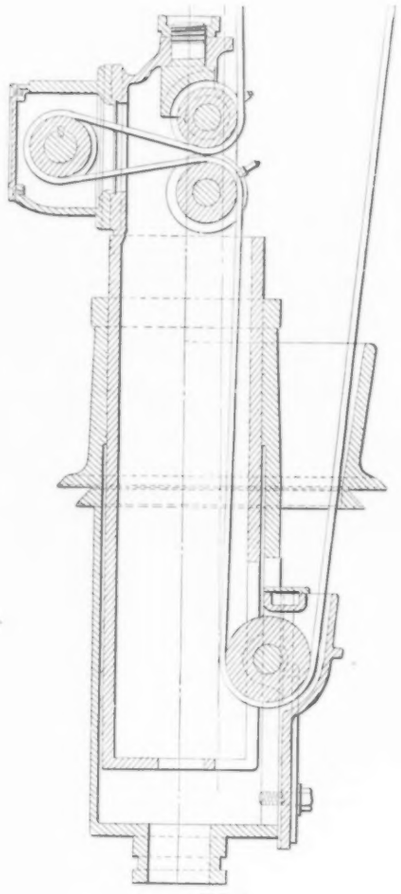


FIG. 2

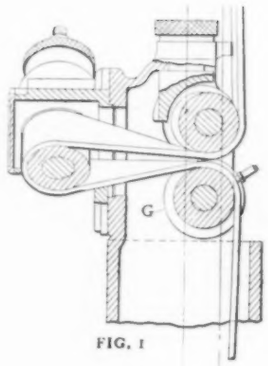


FIG. 1

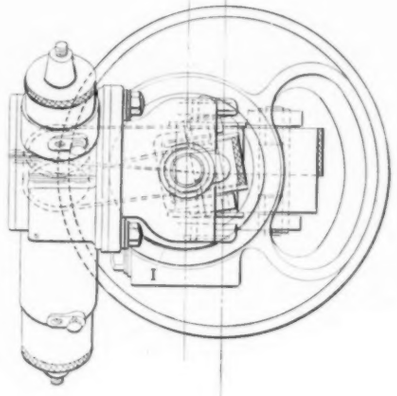


FIG. 3

DETAILS OF THE BELT DRIVE

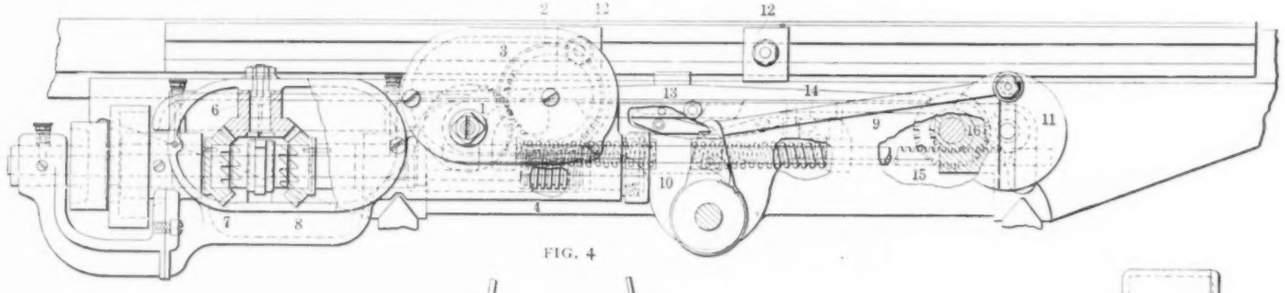


FIG. 4

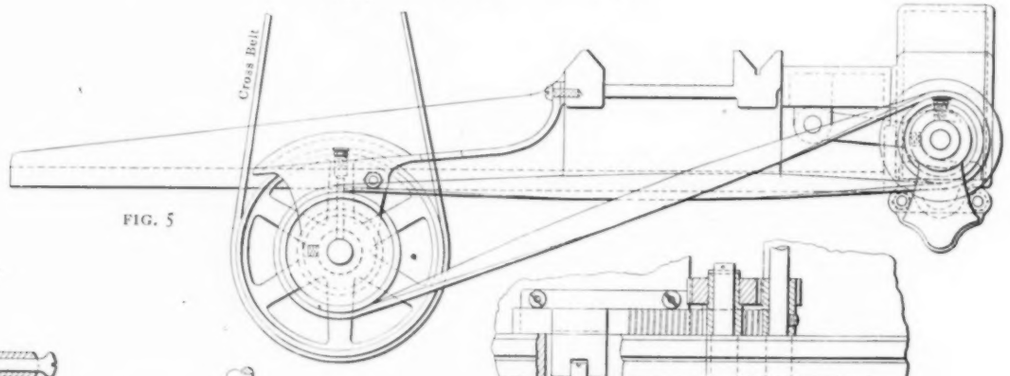


FIG. 5

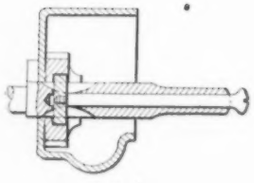


FIG. 6

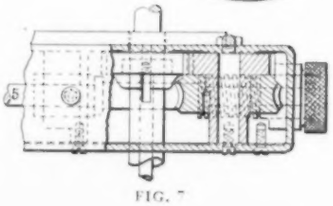


FIG. 7

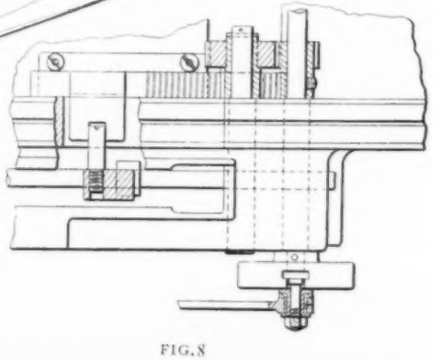
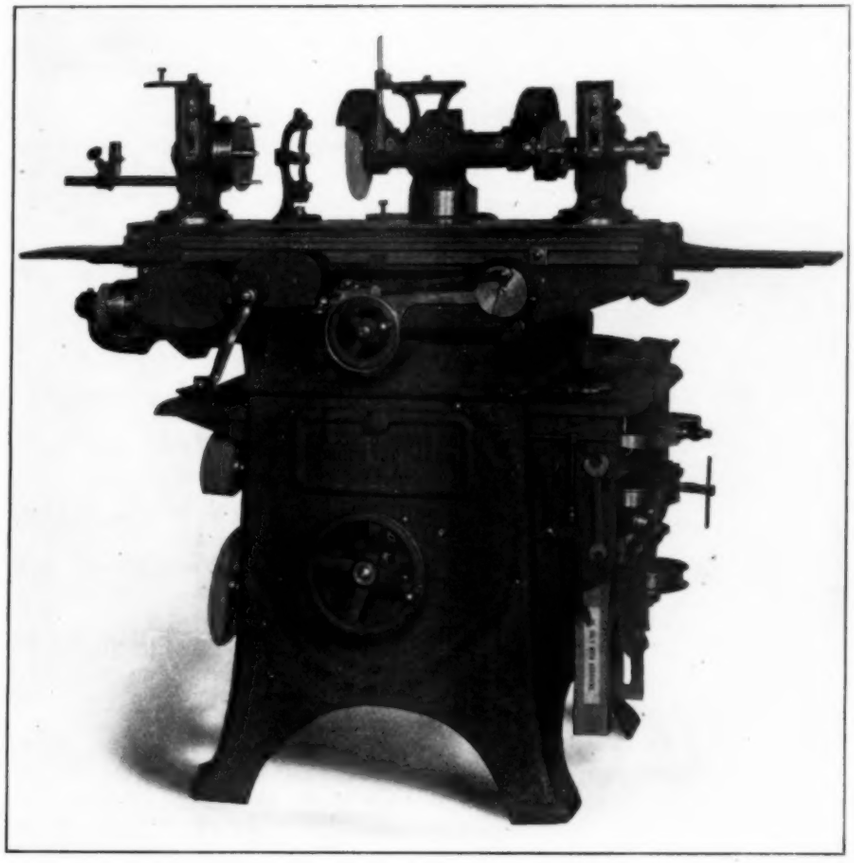


FIG. 8

THE TABLE FEED AND ITS DETAILS



THE WALKER TOOL-ROOM GRINDER

shaft 5 in Fig. 7. A bevel gear set 6, 7 and 8 provides the reversing mechanism. Feed is obtained by the belt, shown in Fig. 5, running on the step pulley, the main feed belt being crossed and running down from the overhead work. The cross-feed is operated by the connecting rod 9 which oscillates the arm 10, the pawl giving any feed desired according to the throw of the crank pin on disk 11. Another ratchet wheel behind the other, with teeth reversed, gives the opposite feed. The movement of the cross-slide is controlled by platen dogs 12 which move slide 13, which has a projection carrying stud 14, which in turn moves the rack 15, compound gear 16, and so turns the disk 11.

This machine is known as the 2-K cutter grinder, is fitted with the full, multiple-speed overhead works, and is built by the Walker Grinder Company, Worcester, Mass.

Automatic Quick Return for a Lincoln Milling Machine

In this machine the quick return of the table after the completion of the cut is entirely independent of the speed of the milling cutter, being driven by a separate belt from the overhead work, as shown in Fig. 1. During the cut the quick-return belt runs on the idler pulley, as shown in Fig. 2, and remains in this position until the dog 11, shown in Fig. 1, strikes the trip and releases 12, which allows the worm to drop away from the gear. At the same time the quick-return dog 3 comes into play, releases lever 1 and throws the belt on the outer pulley by means of the shipper rod 4. The friction 14 slips until the worm is clear of the gear, but immediately thereafter drives the chain and handwheel which controls the quick return of the table. As soon as the table has been returned to its proper position the lever 1 is thrown back, shifting the belt again onto the inner pulley and stopping the table until the finished work has been replaced by a new piece and the table again started by the operator.

This also provides for a quick movement of the table by hand and the automatic feature affords a considerable saving in time, especially on long work. It is made by the Carter & Hakes Machine Company, Winsted, Conn., and applied to their milling machine of the Lincoln type.

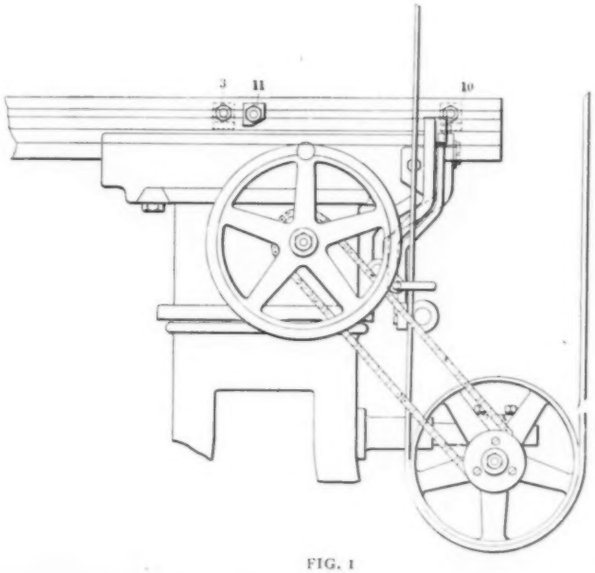


FIG. 1

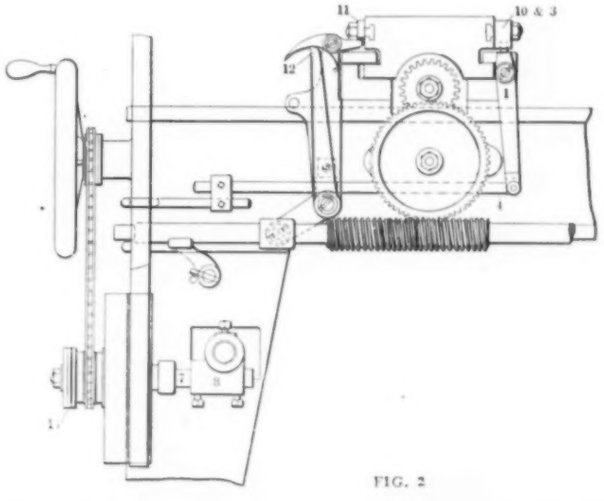


FIG. 2

AUTOMATIC QUICK RETURN FOR LINCOLN MILLING MACHINE

A Large Disk Grinder

This is, perhaps, the largest disk grinder made, the disk or web being 6 feet 9 inches outside, and the outer edge of the emery ring just 6 feet in diameter. This gives practically the same speed at all parts of the grinding surface, and about 18 square feet of abrasive, counting both sides, to work on. When dull it can be trued up with any kind of a wheel dresser.

These grinders have been at work in the builder's own shop for over two years,

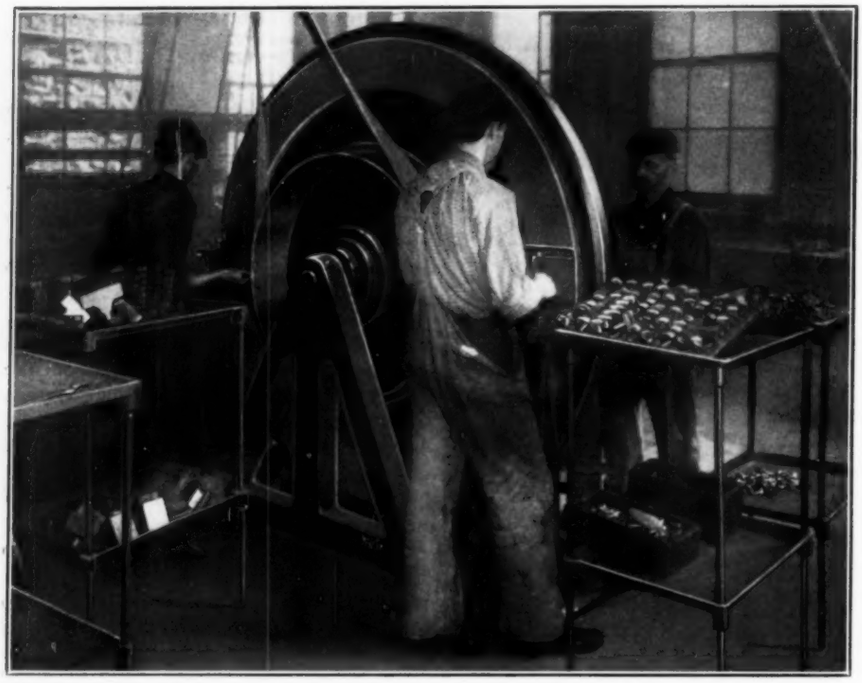


FIG. 1. A LARGE DISK GRINDER

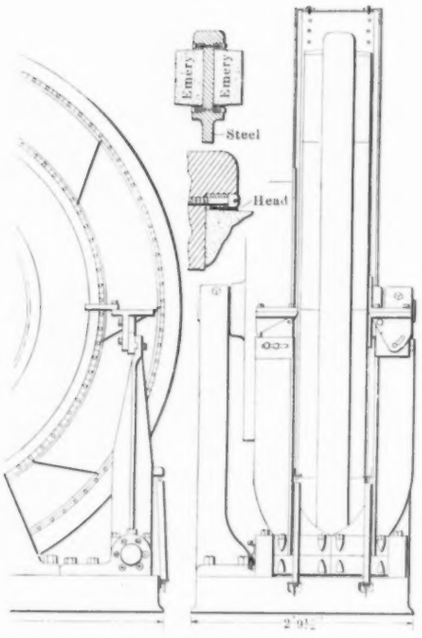


FIG. 2. DETAILS OF DISK GRINDER

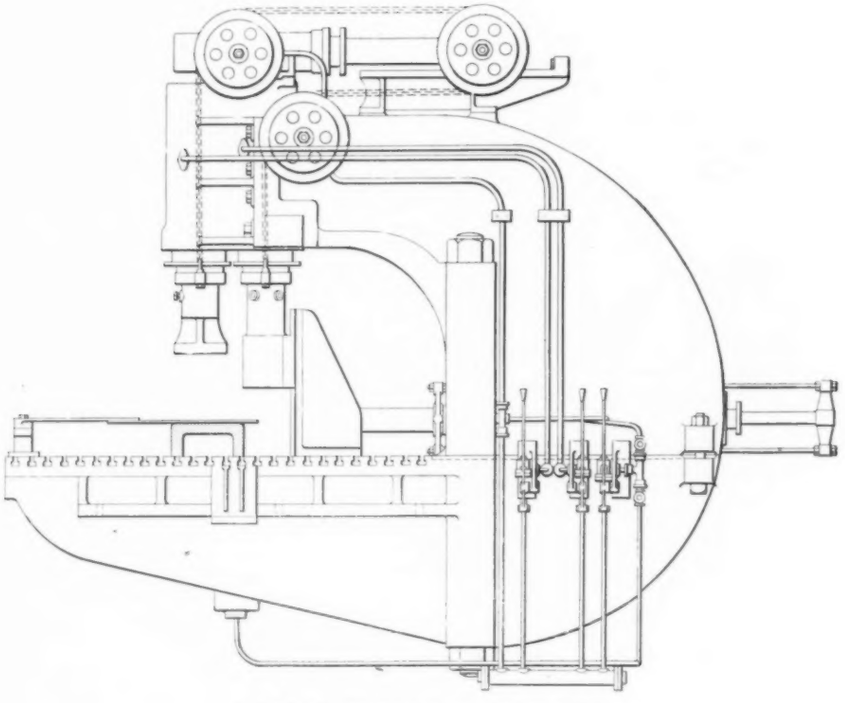
runs on Timken roller bearings, adjusted to insure rigidity in each direction. There are nine specially molded abrasive blocks on each side of the disk, 8 inches wide and 4 inches thick, fitting each other at an angle so as to avoid a square joint. This and the abrasive blocks are regularly worn down to ½ inch in thickness by packing out with wooden strips. As can be seen in the detail sketch, the blocks are held in place by clamps acting on lead strips and they are held at many points, on each side of the block; it makes a very safe fastening.

The wheel center is at a convenient hight, which makes it possible to work four men at each wheel, as seen in Fig. 1. They have been used very successfully to grind high-speed steel, at a speed of about a mile a minute, a 6-inch belt on a 36-inch pulley being used. They are made by the O. K. Tool Holder Company, Shelton, Conn.

A Large Sectional Flanging Press

This is designed for the flanging of very large sheets which have to be done in sections and have a total capacity in the gap, counting from the outer end of the flanging table of 10 feet 6 inches. There are two vertical rams, as shown, the front being usually employed to hold the sheet against the form while the rear plunger does the flanging.

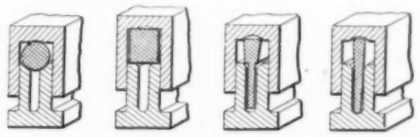
There is also a ram below the center of the table half way between the two upper rams which can be used in double flanging, such as locomotive firebox back sheets where the flanges for the shell and fire-door are turned in opposite directions, and a horizontal ram for side flanging. The cylinders have 30-inch stroke with 1500 pounds pressure per square inch and 13½ inches in diameter. The capacity of the press is 200 tons. It is built by William H. Wood, Media, Penn.



A 200-TON SECTIONAL FLANGING PRESS

Tait Universal Tool Holder

This tool holder consists of two parts, a base in the form of an inserted T and having a slot in the center of the web. Over this is a cover which may be likened to a channel iron and the various tools are held between the two, as shown in the illustrations.



TAIT UNIVERSAL TOOL HOLDER

These show some of the shapes that can be readily and firmly held, and include the round boring tool, any large square-shanked tool, or parting tools of the narrow type, as shown. The whole thing is slipped through the ordinary tool post, or can be held in any type that may be used. This is made by the Van Doren Manufacturing Company, 89 West Jackson boulevard, Chicago, Ill.

Some Essentials of True Leadership

By Philip Bellows

There are two distinct types of men to be found at the top of most industrial enterprises. The fact that is most evident in the relationship of the man to his position is, in the case of one type, that he is always bigger than his job and of the other that he is always smaller than his job. Now the enterprise that is ruled by a man of the second type invariably has to get rid of its leader, or go to the wall. So long as he directs its affairs he will, by his methods, or lack of the same, be continually choking the life of the concern.

In no respect is a man's unfitness to manage large affairs more easily detected than in his attitude toward his assistants. If he is conscious of a lack in himself of any qualification necessary to success he is probably at the same time so full of egotism that he would rather allow the business to suffer detriment and loss, than permit a subordinate to supply his deficiencies. A man of this type often parts with those around him who are best fitted to aid him in conducting successfully the enterprise and fills their places with inferior material; choosing men who are as far behind in their qualifications for success as he is himself. If he does not actually lose his best men he will, by his attitude and conduct toward them make it impossible that their ability and fitness be used to the fullest extent.

Recognizing Talent in Others

The greatest leaders of men, and this is true, I believe, in every line of human endeavor, have always been those who could detect, most readily, latent talent in others and turn it to their own profit. The unsuccessful leaders have in the majority of cases been those who, besides lacking sufficient foresight to be able to lay out their plans for the morrow, next month, or next year, lacked also sufficient insight to enable them to select from the men around them those best fitted by nature, talent, experience and temperament to assist them as leaders among the forces which they controlled. The key to success in leadership lies in the capacity of the leader to make his lieutenants and sub-lieutenants, representatives of himself to the division of the army of workers each controls. Therefore, the man who lacks foresight and insight can never be a leader no matter how great his other mental characteristics may be. It is for this reason that so many meritorious inventions have come to nothing and been lost to the world, because the inventor was chosen as the leader in the business of putting his invention on the market. It is in the nature of things for the inventor to be so absorbed in his invention that he cannot devote his mind sufficiently to looking ahead and providing for many factors necessary to the success of the enterprise. Furthermore, the close application on his part to the one idea and its development and ultimate fruition have, unavoidably, deprived him of the opportunities to study men, and without this study his insight into their qualifications will never be developed. For it is only through personal experience that we can get such knowledge.

Unless his assistants have faith in him and in his possession of these two qualifications, the cohesion and unity of action necessary to the successful operation of any machine or enterprise will be lacking, and no matter how strong the edifice may be upon which he rests, his deficiency will prove a disintegrating force. If you go through the plant of a successful enterprise you will generally notice that, no matter how great the difference in type between the head and his corps of assistants, each one has been chosen for some special qualification that made him just the right man for his particular place. Enter, on the contrary, a plant where every position of any consequence seems to be filled by the proverbial round peg in a square hole and you may know at once that the leader is no leader at all, but a figure head, and no matter how great its past record, unless a radical change is made, ultimate disaster will overtake that concern.

From Inspector to Manager

An incident in the history of a man who is now the operating head of the world's largest locomotive shops, comes to my mind. It occurred in these same shops, but when he was there as an inspector representing one of the country's greatest railroads. A dispute arose between himself and the superintendent of the erecting shop over a cylinder casting, which the cylinder gang was about to build into one of his engines. He saw that the casting was defective, and though the defect was so slight as to be apparently unimportant, he was too keen to allow it to pass. The superintendent argued for putting the cylinder in; the inspector stood for keeping it out. However, the dispute had not gone far when he seized a sledge hammer which lay at hand and swung it with all his might upon the weak spot in the casting. The dispute was ended by the simple process of despatching the cause of it to the scrap heap. Shortly after this a representative of the locomotive company came to him and offered him a berth.

Someone with the foresight of a true leader had realized that with such a man at large in the locomotive world it was impossible to tell whether it would be cylinders, or their whole business, that might next be demolished. It was safer to get him roped in.

He is now the operating head of the company, and one of its directors. Aided by his energy and ability that great concern has grown until now, if I am correctly informed, its output about equals that of all other private locomotive shops in America.

From Draftsman to Superintendent

Another incident in connection with the same great leader which is just as characteristic of the man, illustrates another point. One of the designers had made a bad record for himself as the author of many mistakes which had gone out into the shops and caused trouble. Sammy was the name by which he went, and all who knew his work felt that the time was fast approaching when Sammy would be requested to leave them. It should be stated, that along with his faculty for getting himself into trouble went a wonderful ability for getting out again. For whenever one of his mistakes was located he showed a perfect genius for correcting the error with minimum delay, and many of his achievements in this line were a source of wonder to his comrades. At last the crisis came; a blunder or omission which could not be overlooked was the cause one day of a visit on Sammy's part to the office of the superintendent, our whilom locomotive inspector. What was the astonishment in the drawing office when it was announced that Sammy was slated for promotion instead of discharge! I have forgotten the exact position into which he was put, but it was near to the head of the repair department. The superintendent had observed something that no one else, not even Sammy himself, had noticed. He was placed wrongly; in his right place he might be one of the most useful men in the employ of that great concern. His

ability to repair his own mistakes was henceforth to be utilized in repairing the mistakes of others. Thus we see how the true leader could discern the qualifications for successful lieutenantship where another would see only incompetence and failure.

In the other instance, the man who, when he heard of the unexpected and unusual course taken by the obscure locomotive inspector, detected in it something more than an outburst of temper and was able to perceive the peculiar fitness for responsibility of such a man, must have been himself a great leader; big enough in every way to discover and be willing to acknowledge the same qualities in another and turn them speedily to account.

An Unusual Crane Girder Design

By D. S. Barrow

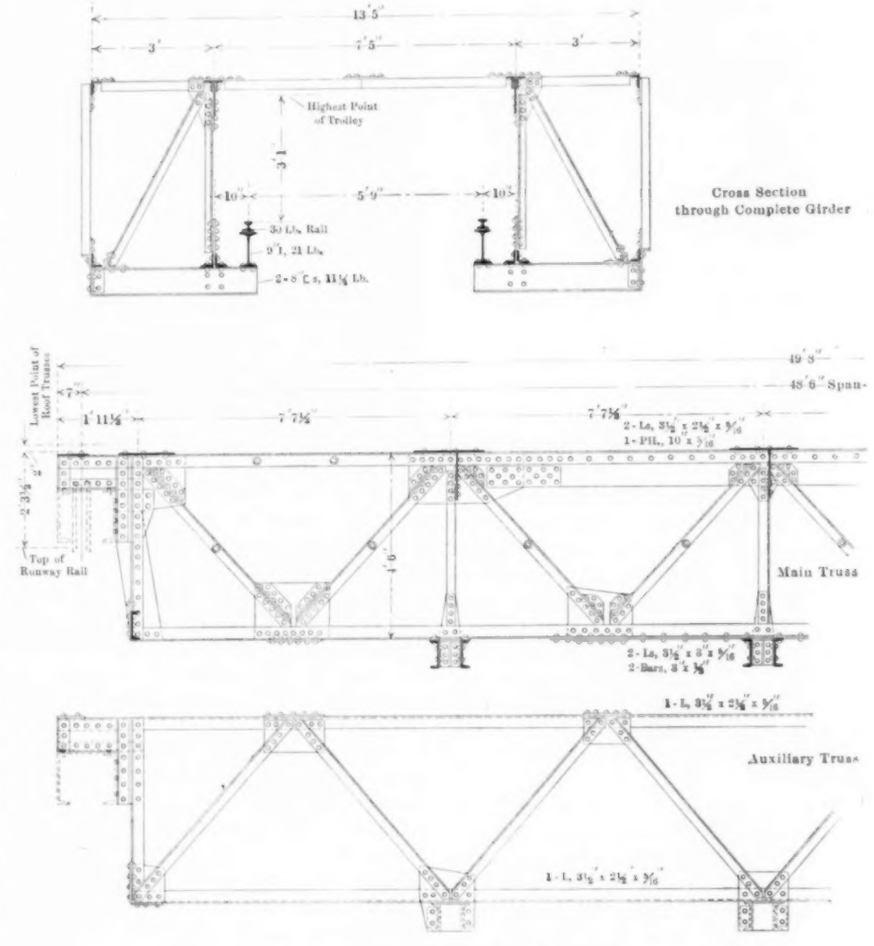
The crane girders shown in the accompanying drawings were designed by me to meet unusual conditions, and it is believed that certain features are novel. The clearance between the top of runway rail and the under side of the roof trusses was so small as to prevent the use of the usual end truck connections, even with a standard trolley.

The specifications required that all motors should be capable of handling the maximum load at full speed for a period of two hours without exceeding a certain very low temperature rise. This necessitated the use of motors several sizes larger than the ordinary and made a very bulky trolley.

I have never been in favor of the submerged type of trolley running on the lower flanges of plate girders, because of the local bending and twisting moments which this produces, and the inaccessibility of the working parts. In the present case the great depth required would have made such a design uneconomical as to material, and the necessity for carrying channels or other suitable members across the tops of both girders to resist the lateral load through inclined struts would have lowered the trolley about 10 inches. Furthermore, our standard trolley had bearings on each side of the track wheels, which would have prevented its use in this type of girder.

The rails for the trolley were attached by hook-bolts to the top flanges of 9-inch beams, which in turn rested on the cantilevered ends of 8-inch channels suspended in pairs from the main trusses, the outer ends being supported by the auxiliary trusses. All details were worked out so that no rivets should be in tension. Each main truss was connected to its auxiliary by a bottom lateral system, of which the 8-inch channels formed the struts, interior diagonal bracing, and a top lateral system. Lateral braces also connected the top chords of both main trusses.

It will be noted that the cover plates on the bottom chords of the main trusses were divided to allow attachment of the connection plates from the cantilevered channels direct to the vertical ties. These ties might have been eliminated by supporting the 8-inch channels from the lower panel points rather than the upper ones, but this would have required extending the main gusset plates through, and biting out the corners so as to pass between the channels. It would also have interfered with the bottom lateral system.



AN UNUSUAL CRANE GIRDER DESIGN

The design shown is not by any means the only way of getting around the difficulties the conditions raised, and is perhaps not the best one, but the reasons which dictated its adoption were deemed at the time to be sound.

The new customs tariff for Denmark which went into effect on January 1, 1909, makes considerable changes from the existing duties and it is noted that in electrical machinery there is a reduction from 10 to 7½ per cent. ad valorem and in other machinery not specifically tariffed the reduction ranges from 10 to 5 per cent.

Business Items

The Potter & Johnston Machine Company, Pawtucket, R. I., is very busy on its line of manufacturing automatics, and has an addition of 12,000 square feet now in course of construction to take care of their increased business.

The Youngstown plant of the Republic Iron and Steel Company has equipped its spike department with the fuel oil system manufactured by Tate, Jones & Co., Pittsburg.

We acknowledge with thanks receipt of calendars from the following firms: Schumacher & Boye, Cincinnati, O.; Western Gas Engine Company, Los Angeles, Cal.; American Blacksmith Company, Buffalo; American Woodworking Machinery Company, Rochester; Triumph Electric Company, Cincinnati; Kutztown Foundry and Machine Company, Philadelphia.

J. J. McCabe, No. 30 Church street, New York City, the well-known machinery dealer and manufacturer of "2-in-1" double-spindle lathes, requests us to again publish warning against an impostor now traveling through the country under the name of "Eddie Ward," and misrepresenting himself as traveling salesman in McCabe's employ. It was only this summer an account was published in this paper of how Ward buncoed a shop in Oregon City, Ore., by collecting a deposit on a machine represented by Ward as part of McCabe's stock. While nothing has been heard of Ward since that time, he has now turned up according to

latest reports at West Point, Miss., and Talladega, Ala., and has resumed operations again. This time he collected from F. A. Bentley, of the West Point Machine Works, a deposit on a trade he proposed. The Talladega Foundry and Machine Company gave him a deposit on the purchase of a "Hendey" lathe which was represented as belonging to Mr. McCabe, for shipment from some point in Mississippi. J. J. McCabe has no traveling man whatsoever at present through the South or West, as he is represented in these sections by machinery dealers. Every effort is being made by the McCabe firm to run down this impostor, and he will be severely dealt with when caught.

Trade Catalogs

The Foote-Burt Company, Cleveland, Ohio. Circular illustrating and describing No. 24 high duty drill.

Honore Demoor & Cie, 299 Chaussee D'Anvers, Brussels, Belgium. Catalog of lathes. Illustrated, 30 pages, 6x9 inches, paper.

Eck Dynamo and Motor Company, Belleville, N. J. Binder containing bulletins of dynamos and motors. Illustrated, 5x8½ inches.

Western Electric Company, 463 West street, New York. Bulletin No. 5910-9 describing electrical equipment for central stations. Illustrated.

New Departure Manufacturing Company, Bristol, Conn. Catalog describing two-in-one ball bearings. Illustrated, 24 pages, 6x9 inches, paper.

The Standard Electric Time Company, Boston, Mass. Bulletin No. 11, describing self-winding clock systems. Illustrated, 40 pages, 8x10½ inches.

Rathbone Molding Machine Company, 44 Buhl Block, Detroit, Mich. Catalog of multiple molding machine. Illustrated, 32 pages, 6x9 inches, paper.

Carter & Hakes Machine Company, Winsted, Conn. Catalog describing Lincoln milling machines, hand milling machines, screw and lever vises. Illustrated, 16 pages, 6x9 inches, paper.

Ferracute Machine Company, Bridgeton, N. J. Temporary catalog No. 16, describing drop presses, power presses, toggle drawing presses, coining presses, etc. Illustrated, 68 pages, 4½x6 inches, paper.

American Blower Company, Detroit, Mich. Pamphlet No. 246, entitled "Shop Heating." Illustrated, 12 pages, 7x9 inches. Pamphlet No. 247 describing Detroit steam traps. Illustrated, 16 pages, 7x9 inches.

The National-Acme Manufacturing Company, Cleveland, Ohio. General catalog of Acme automatic multiple spindle screw machines and Acme semi-automatic screw slotting machines. Illustrated, 92 pages, 7x9 inches, paper.

Business Opportunities

The Vincennes (Ind.) Bridge Company is building an addition.

The Anchor Fence Company, Fort Worth, Texas, will enlarge its plant.

C. W. Mann, Evington, Va., contemplates installing sawmill machinery.

W. E. Dinnenn, Cheyenne, Wyo., will build an automobile garage and machine shop.

The Frontier Iron Works, Buffalo, N. Y. is considering plans for extending its plant.

The West Shore Railroad Company is building a new roundhouse at Newburgh, N. Y.

The Bessemer (Ala.) Soil Pipe Company will spend $100,000 in improvements at plant.

The Empire Grate Company, Chester, Penn., is negotiating for site on which to erect a foundry.

The New Process Rawhide Company, Syracuse, N. Y., will erect a $20,000 addition to plant.

The Stetler Paper Box Company, Spokane, Wash., has purchased site for a new and larger factory.

The Independent Steel and Wire Company, of Pittsburg, will erect a $3,000,000 plant at Fairmount, Va.

The Campbell Glass and Paint Company, St. Louis, Mo., will rebuild plant recently destroyed by fire.

The Lovelace Lumber Company, Brewton, Ala., will rebuild sawmill and basket factory recently burned.

Groskopf Bros., Grand Rapids, Mich., are planning the erection of a factory for the manufacture of trunks.

The Bridgeport (Conn.) Vehicle Company has awarded contract for the construction of a new plant to cost $60,000.

It is reported that the E. W. Bliss Company, Brooklyn, N. Y., will enlarge plant as a result of government contracts for torpedoes.

The plant of the James Ballantyne Company, plumbing contractors, Winnepeg, Man., has been destroyed by fire. Loss, about $35,000.

Felker Bros. Manufacturing Company, Sparta, Wis., will locate in Marshfield, where plant will be erected to manufacture galvanized steel tanks, etc.

The A. O. Kehm Casting Company, Birmingham, Ala., will erect a foundry at North Birmingham for the manufacture of blast furnace and mine castings.

The Conley Incinerator and Manufacturing Company, Leavenworth, Kans., will establish plant in Oklahoma City for manufacturing incinerator plants.

The Triumph Electric Company has started the erection of its new factory at Oakley, Ohio. This is to be modern in every respect and will cost about $75,000.

Otto Heditke, Buffalo, N. Y., is erecting a two-story brick machine shop for the manufacture and repair of automobile parts, for which equipment will be needed.

The Snell Manufacturing Company, Fiskdale, Mass., whose plant was recently destroyed by fire, will rebuild. The company manufactures augers and auger bits.

The Sanford (Fla.) Carriage Works will erect building and install machinery for manufacturing buggies and wagons. Will also install general blacksmithing equipment.

The Central Manufacturing Company, Connersville, Ind., making wooden automobile bodies, will erect an addition to be used for the manufacture of metal bodies.

Pilkington & Daly, Roseburg, Ore., are erecting building to be used as machine and blacksmith shop and automobile garage. The erection of a foundry is also contemplated.

The Standard Lumber and Manufacturing Company, Athens, Ga., has been incorporated with $50,000 capital. Will establish plant for the manufacture of sash, doors and blinds.

The Babbett Cotton Picker Company, Little Rock, Ark., has been incorporated to manufacture cotton picker invented by H. A. Babbett. Capital $125,000. H. S. Kennedy, president.

It is reported that the Gray Lumber Company, of Cleveland, Ohio, will establish sawmill at Antlers, Okla., and also construct a railroad between Little River timber district and Antlers.

The Central Indiana Fence and Wire Company, Kohomo, Ind., has been incorporated with $10,000 capital for the purpose of manufacturing woven wire fence. E. E. Scott, E. J. Scott, etc., incorporators.

The plant of the Puget Sound Mills and Timber Company, at Bellingham, Wash., said to be the largest shingle mill in the world, was destroyed by fire, causing a loss of over $400,000. It is said mill will be rebuilt.

The Irondale Steel Company, Seattle, Wash., has been organized with James A. Moore as president. The company will erect two open hearth furnaces at Irondale, Wash. The company is capitalized at $1,000,000.

The Memphis (Tenn.) Steel Construction Company, recently formed, has secured building and will establish plant for the manufacture of structural steel and bridge material. George R. James, W. A. Hein and others are organizers.

The American Locomotive Company has purchased site at Gary, Ind., and plans are being drawn for a plant which will employ over 12,000 men, it is said. The company now operates plants in Schenectady and Dunkirk, N. Y.

The Automatic Transportation Company, Buffalo, N. Y., has purchased site on which plant will be erected. Machine shop will be erected right away and foundry and other buildings later. A lot of iron working machinery will be installed.

The Jeffrey Manufacturing Company, Columbus, Ohio, will make extensive improvements to plant. New buildings will be added and existing buildings enlarged. The company manufactures mining machinery, power transmitting machinery, etc.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., February 1, for electric motors, chain blocks, tackle blocks, rivets, nuts, hammers, wrenches, chisels, machinists' clamps, lubricating grease, etc., as per Circular No. 488.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: January 26 Motors (schedule 808). February 2 Universal grinder, bench lathe, engine lathes, grinding and polishing machine, milling machine, electric motor, drill press, shaper (schedule 811). February 9 Air compressor (schedule 822), complete equipment for forging tools (schedule 813), steering engine (schedule 823), engine lathes (schedule 822). February 23 Flat turret lathe, milling machine (schedule 815).

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E. G. Smith Co., Columbia, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, Amer. Mach.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Machinery, built to order; up-to-date plant. Write Brunswick Refrigerating Co., New Brunswick, N. J.

Machines designed; automatic, special. Practical working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Experienced mechanical engineer wants parties to take up the manufacture of cheap automobiles. Box 856, American Machinist.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MACH.

Wanted—Manufacturer to make and sell a "cut meter;" for determining cutting speeds on metal. Good business opportunity. Full information on application. Address "F. M. C.," No. 37 Lynwood Place, New Haven, Conn.

New patent laws. A firm of high-class machine toolmakers with modern plant (including foundry) are prepared to undertake the manufacture of suitable patented specialties on behalf of foreign patentees who are desirous of complying with the new patent laws. Roberts Bros., Dukinfield, Manchester, England.

Sell your tools in the Far East. The only successful method is to have your own representative in the field. This method opens a field of immense possibilities for you worth investigating. I want to hear, in confidence from, at most, ten manufacturers who will share the costs of such representation. It will be to your advantage. A. Gwajkokuijin, Box 839, AMERICAN MACHINIST.

Manufacturer wishes complete information covering the best and cheapest method of etching on hard steel, such as saws, rules, safety razor blades, etc. Process must produce clear, sharp work, yet be very cheap. In replying, state price wanted for the information and name several articles etched by your process, together with the cost of doing the work. If possible, submit samples, naming cost of etching. Box 827, AMERICAN MACHINIST.

The annual meeting of the stockholders of the Hill Publishing Company, for the election of directors for the ensuing year and for the transaction of such other business as may properly come before the meeting, will be held at the office of the company, in the Hallenbeck building, 497-505 Pearl street, Borough of Manhattan, New York City, N. Y., on Tuesday, January 26, 1909, at 12 o'clock noon.

Dated, New York City, December 19, 1908.

Robert McKean, Secretary.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—Position as draftsman by experienced detailer and practical toolmaker. Box 830, AMERICAN MACHINIST.

Practical mechanic with 15 years' experience as superintendent on small and medium duplicate manufacturing, desires position handling 50 to 100 men; can design special tools for cheap and rapid production; hustler and originator, salary moderate. Address Box 814, AMERICAN MACHINIST.

DELAWARE

Situation by man of 36 with 20 years' practical experience in medium and small machinery (gasolene engines and small tools). Thorough business experience and capable of designing and estimating. Box 823, AMERICAN MACH.

ILLINOIS

Tool room foreman desires change; first class on tools for adding machines, cash registers and typewriters. Box 764, AM. MACH.

Machine tool designer, 14 years' broad shop and drafting experience wants change; position as foreman or assistant to superintendent preferred. Box 863, AMER. MACH.

Superintendent or master mechanic, age 35, married, holds at present and for years such position with large manufacturing concern. Thoroughly familiar with most modern methods in manufacture and cost reducing systems. Started at the bottom, have large experience, can furnish excellent reference and show a successful record. For good reasons wish to make change about April 1. Box 849, AMERICAN MACHINIST.

INDIANA

At liberty, superintendent or works manager; ten years' practical experience; successful organizer and systematizer on economical production. Address "Superintendent," 1105 No. Alabama St., Indianapolis, Ind.

MASSACHUSETTS

I wish to correspond with any company desiring the services of a progressive and up-to-date manufacturing superintendent. Box 864, AMERICAN MACHINIST.

Graduate mechanical engineer, first class designer with excellent experience in steam turbines, pumps and general machinery, would like position as designing engineer or chief draftsman. References of well known concerns. Box 850, AMERICAN MACHINIST.

MICHIGAN

Foreman toolmaker and designer of special machinery and tools for reducing cost of manufacture, wants employment near Chicago. Box 859, AMERICAN MACHINIST.

MISSOURI

Position wanted by mechanical engineer with ten years' mechanical and electrical experience. Present position—chief draftsman. A good executive, hustler, systematizer and correspondent with uptodate methods; age 30; salary expected, $1800; will locate anywhere. Box 853, AMERICAN MACHINIST.

NEW JERSEY

An inventive, thorough, broadly experienced mechanic, practical toolmaker; an organizer, proven ability, wants change; responsible position. Reliable firms only. "Ability," AMERICAN MACHINIST.

Wanted—Position as superintendent by one who has worked up from the bench; having had 20 years' experience along the line of type-casting machines, typewriters, electrica instruments and tools for interchangeable work; open for engagement Feb. 1, 1909. Address "Ambitious," AMERICAN MACHINIST.

NEW YORK

Draftsman, experienced, seeks position. Box 860, AMERICAN MACHINIST.

Let me see if I can reduce the expenses of your shop. Mechanical engineer. Box 857, AMERICAN MACHINIST.

Mechanical draftsman, graduated from Technikum and experience, wishes position. Box 855, AMERICAN MACHINIST.

First-class draftsman, technical education; Corliss or high-speed engines; wants position. Box 867, AMERICAN MACHINIST.

Machinist competent to superintend and control apprentices to advantage of employer. Capable of producing results in shortest time. Box 866, AMER. MACHINIST.

Mechanical engineer and draftsman; energetic young man with seven years' varied practical experience, desires to make a change. Good references. "H. L.," Box 858, AM. M.

Superintendent or manager, practical and executive, in machine shop and foundry. Up-to-date mechanical and business experience. Best references. W. S. Morehouse, Fishkill-on-Hudson, New York.

General foreman, 22 years' practical experience; expert on steam engine and general work; thoroughly versed in best shop practice; can handle men to advantage and produce results. Box 852, AMER. MACHINIST.

Experienced foreman toolmaker, desires position as foreman of tool room or high-class machine shop, tools, dies, gages, model or experimental work; excellent references as foreman. Box 861, AMERICAN MACHINIST.

General or sales manager; age 42; reliable executive, familiar with the manufacturing and marketing of firearms desires to connect with first-class concern in same or kindred line; preferably located in the East; highest credentials. Address "Experience," AM. M.

OHIO

Superintendent, chief engineer and designer, 12 years' practical experience, thoroughly versed in best shop practice; executive ability, and an inventor; prefer small company that wants to improve their line; any locality. Box 810, AMERICAN MACHINIST.

Engineer of established reputation, wide experience apprentice to works manager, intimate knowledge of best shop and machine tool practice on heavy work, gilt-edged record, is open for engagement as works manager with full responsibility and can deliver the goods. Box 865, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—Manager for a business with financial and manufacturing problems, and large prospective growth. He must have large executive and organizing ability, backed by exceptional energy. Extensive shop and business experience needed. If not qualified, don't apply. The right man can get big salary. Applications will be treated confidentially. "Typewriter," P. O. Box 1106, Hartford, Conn.

ILLINOIS

Superintendent for screw machine factory. Must be thoroughly competent. Fine opportunity for the right man. Duce Mfg. Co., care Chas. T. Frantz, 505 Commercial National Bank Bldg., Chicago.

MASSACHUSETTS

Wanted—By concern 20 miles from Boston, experienced draftsman on special machinery. Replies should give age, education, experience in detail, and salary expected. Box 847, AM. MA.

MICHIGAN

Foreman wanted by machine shop making high-class machinery, employing about 50 men; must be capable and experienced, able to handle men to advantage; state experience, age and wages expected. Address Box 797, AMERICAN MACHINIST.

Wanted—Experienced operator on Potter & Johnston turret machines, who is competent to take charge of several machines, turning out good work advantageously. State experience handling men, wages, age, nationality. We want a man who can turn out a maximum amount of good work. Box 838, AM. M.

NEW JERSEY

Wanted—Draftsman on special machinery; must have shop and drawing room experience. Man with executive ability preferred. State age, experience and give reference and salary. Box 788, AMERICAN MACHINIST.

Salesman—A traveling salesman who is now selling the machine or railroad supply trade, to carry a high grade bearing metal (babbitt) as a side line, on liberal commission basis. Address, with full particulars, Lakewood Metal Co., Box 182, Lakewood, N. J.

NEW YORK

Wanted—Superintendent of manufacturing department in water meter factory. Box 818, care AMERICAN MACHINIST.

Wanted—Purchasing Agent—A bright, active, young man with technical education, knowledge and familiarity with good printing is essential. Apply "X. P.," Box 117, 617 6th Ave.

OHIO

Toolmaker; one competent to make tools for rolling and drawing sheet metal. Box 791, AMERICAN MACHINIST.

Wanted—Competent sales manager by a machine tool manufacturer. Liberal salary to a very high class man. Box 833, AMER. MA-

Wanted—Designer and draftsman experienced on sheet-metal working machinery and automatic feeds for same; state experience and salary expected. Box 815, AM. MACH.

Wanted—A superintendent by a company manufacturing 14″ lathes; a rare chance for one that can buy over the stock of our present superintendent. Box 862, AMER. MACH.

PENNSYLVANIA

Tool room foreman who is up-to-date in all modern methods of getting out new tools, jigs and fixtures at the lowest possible cost. We have steady position for A-1 man of good habits. Box 819, AMERICAN MACHINIST.

Wanted—Traveling inspector to trace and chase in automobile parts; must be of good address, energetic, sober and thoroughly familiar with machine inspecting practice; give reference and salary desired. Box 854, AM. M.

RHODE ISLAND

Assistant manager or shop manager wanted by manufacturer having drop forge plant, machine shop, polishing and nickeling plant. A practical mechanic experienced in superintending, familiar with cost system and designing of labor-saving machinery and tools. No one but a reliable, competent and successful man with or without capital need apply. Box 851, AMERICAN MACHINIST.

FOREIGN

Professorship in mechanical engineering. The Norwegian government (church and educational department) desires to appoint a professor in mechanical engineering for the Tekniske Hiskole (Polytechnic Institute), at Trondhjem, Norway. The Polytechnic Institute will probably be opened after the summer of 1910, but the appointment may date from the beginning of 1909, the professor meanwhile assisting in laying out plans for engineering laboratory and such other preparatory arrangements as he may be able to undertake. As it is conceivable that some time may elapse after the remuneration, as above mentioned, with the plans. The professor must be sufficiently acquainted with the Norwegian language. The form of application is "To the King," and should be addressed to "Den norske Regjerings Kirke—og Undervisnings—department, Kristiania"—before the end of January, 1909.

For Sale

For Sale—Greenfield Universal tool and cutter grinder, at a bargain. As good as new. Box 837, AMERICAN MACHINIST.

For Sale—One-half interest in machine shop, doing nice business, located in Central Mich. Partner must be able to take charge of shop. Address Box 807, AMER. MACHINIST.

For Sale—A solid brick, steel construction, factory building, with 7½ acres of land near Chicago. Now unoccupied. Size 110x541. Suitable for iron working business. Has engine, boilers, dynamos, etc. Most favorable prices and terms will be given. Chicago Highlands Association, 1315 Wells Building, Milwaukee, Wis.

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Schieren Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.
Smooth-On Mfg. Co., Jersey City, N. J.

Belt Fasteners

Bristol Co., Waterbury, Conn.
Greene, Tweed & Co., New York.

Belt Filler

Schieren Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.
Smooth-On Mfg. Co., Jersey City, N. J.

Belt Lacing Machines

Birdsboro Steel Foundry & Mach. Co., Birdsboro, Pa.

Belt Shifters

The L. & D. Co., Boston, Mass.

Belting, Leather

Chicago Raw Hide Mfg. Co., Chicago, Ill.
Schieren Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Bending Machinery, Hydraulic

Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Phila., Pa.
Watson-Stillman Co., New York.

Bending Machines, Plate

Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.

Bending Machines, Power

Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Bending Tools, Hand

Estep & Dolan, Sandwich, Ill.
Wallace Supply Co., Chicago, I

Blocks, Chain

See Hoists, Hand

Blocks, Die

Nicholson & Co., W. H., Wilkes-Barre, Pa.

Blowers

American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
General Electric Co., New York.
Niles-Bement-Pond Co., New York.
Roth Bros. & Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.

Bolt and Nut Machinery

Acme Mchry. Co., Cleveland, O.
Davis Machine Co., W. P., Rochester, N. Y.
Foote-Burt Co., Cleveland, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Landis Machine Co., Waynesboro, Pa.
Manville Mach. Co., E. J., Waterbury, Conn.
McCabe, J. J., New York.
Milton Mfg. Co., Milton, Pa.
Mummert, Wolf & Dixon Co., Hanover, Pa.
National-Acme Mfg. Co., Cleveland, O.
National Machinery Co., Tiffin, O.
Newton Machine Tool Wks., Inc., Phila., Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Lang Co., G. R., Meadville, Pa.

Bolts and Nuts

Electric Welding Products Co., Cleveland, Ohio.
Milton Mfg. Co., Milton, Pa.
National-Acme Mfg. Co., Cleveland, O.

Bone for Case Hardening

Rogers & Hubbard Co., Middletown, Conn.

Books, Technical

American School of Correspondence, Chicago, Ill.
Hill Publishing Co., New York.
Sames, Chas. M., Jersey City, N. J.
System, Chicago, Ill.

Boosters

Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal

Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Betts Mach. Co., Wilmington, Del.
Detrick & Harvey Mach. Co., Wilmington, Del.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Inc., Boston, Mass.
Lucas Mach. Tool Co., Cleveland, O.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Universal Boring Mach. Co., Hudson, Mass.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Boring and Turning Mills, Vertical

American Tool Works Co., Cin., O.
Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mach. Tool Co., Franklin, Pa.
E. J. Flather Mfg. Co., Nashua, N. H
Gisholt Mach. Co., Madison, Wis.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Mitts & Merrill, Saginaw, Mich.
Newton Machine Tool Wks., Inc, Phila., Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Boring Tools

Armstrong Bros. Tool Co., Chicago, Ill.
Krieger Tool & Mfg. Co., Chicago, Ill.

Box Tools, Roughing

Bardons & Oliver, Cleveland, O.

Brazing

Industrial Oxygen Co., New York.
Sanford Mfg. Co., F. C., Bridgeport, Conn.
Universal Fluxine Co., Urbana, Ohio.

Broaching Machines

Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Inc., Boston, Mass.
Lapointe Mach. Tool Co., Hudson, Mass.

Bulldozers

Bliss Co., E. W., Brooklyn, N. Y.
National Machinery Co., Tiffin, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Cabinets, Tool

Armstrong Bros. Tool Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Calipers

Brown & Sharpe Mfg. Co., Providence, R. I.
Schuchardt & Schutte, New York.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Cams

Bilgram, Hugo, Phila., Pa.
Boston Gear Works, Norfolk Downs, Mass.
Fuller Mfg. Co., New Haven, Conn.

Carborundum

See Grinding Wheels.

Carborundum Paper and Cloth

Carborundum Co., Niagara Falls, N. Y.

Case-Hardening

American Gas Furnace Co., New York.
Rogers & Hubbard Co., Middletown, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Castings, Brass and Bronze

Clum & Atkinson, Rochester, N. Y.
Lumen Bearing Co., Buffalo, N. Y.

Castings, Die Molded

Berry & Parker, Erie, Pa.
Franklin Mfg. Co., H. H., Syracuse, N. Y.

Castings, Iron

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Buffalo Fdry. & Mach. Co., Buffalo, N. Y.
Cell Drier Machine Co., Taunton, Mass.
Erie Foundry Co., Erie, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Taylor & Fenn Co., Hartford, Conn.

Castings, Steel

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.

Cast Iron Brazing

Industrial Oxygen Co., New York.

Cement, Cast Steel

Clark Cast Steel Cement Co., Shelton, Conn.
Obermayer & Co., S., Cincinnati, O.

Cement, Iron

Smooth-On Mfg. Co., Jersey City, N. J.

Centering Machines

Hendey Mach. Co., Torrington, Conn.
McCabe, J. J., New York.
National Machine Co., Hartford, Conn.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Mach. Co., D. E., New London, Conn.

Centers, Planer

Cincinnati Planer Co., Cincinnati, O.
Fay & Scott, Dexter, Me.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving

Boston Gear Works, Norfolk Downs, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Link-Belt Co., Philadelphia, Pa.
Morse Chain Co., Ithaca, N. Y.
Whitney Mfg. Co., Hartford, Con

Chucking Machines

American Tool Wks. Co., Cin., O.
Bardons & Oliver, Cleveland, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co. Cleveland, O.
Galvin Mach. Co., New York.
Gisholt Machine Co., Madison, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Reed Co., F. E., Worcester, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill

Almond Mfg. Co., T. R., Ashburnham, Mass.
Brown & Co., R. H., New Haven, Conn.
Celfor Tool Co., Chicago, Ill.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Modern Tool Co., Erie, Pa.
Morrow Mfg. Co., Elmira, N. Y.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Russell Anti-friction Drill Chuck Co., Elmira, N. Y.
Skinner Chuck Co., New Britain, Conn.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Union Mfg. Co., New Britain, Conn.
Whitman & Barnes Mfg. Co., Chicago, Ill.
Whitney Mfg. Co., Hartford, Conn.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe

Cincinnati Chuck Co., Cincinnati, O.
Cushman Chuck Co., Hartford, Conn.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.

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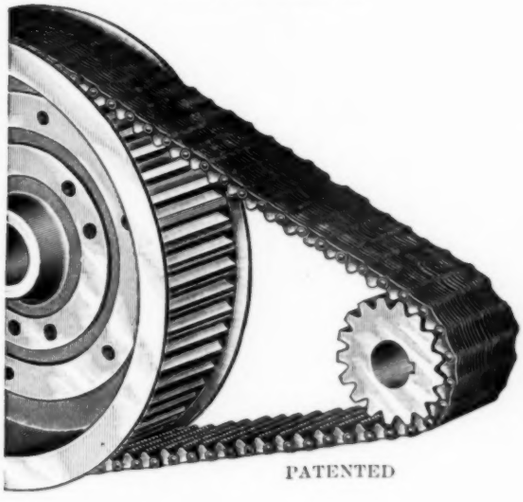
Detachable and Riveted Roller Chains.

All popular sizes.



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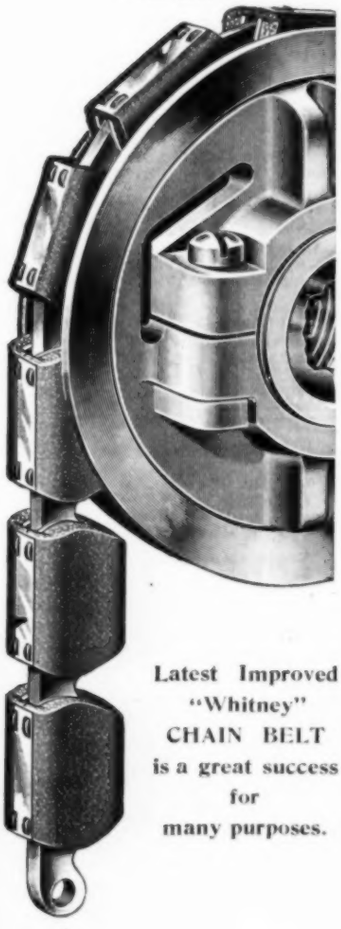
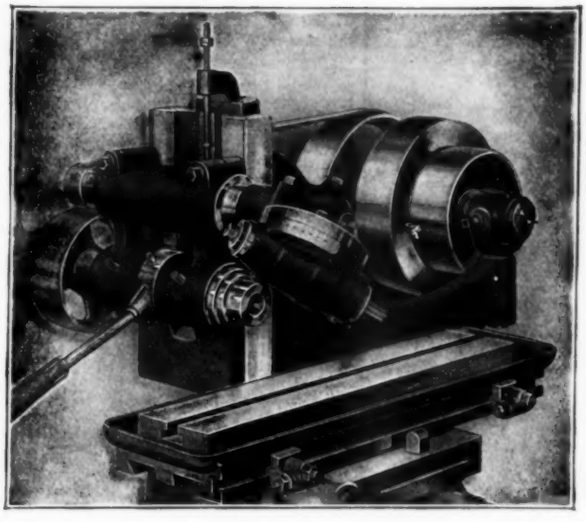
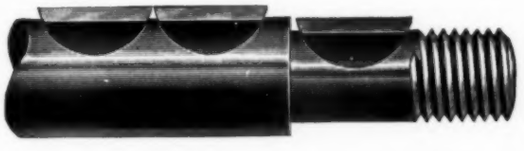
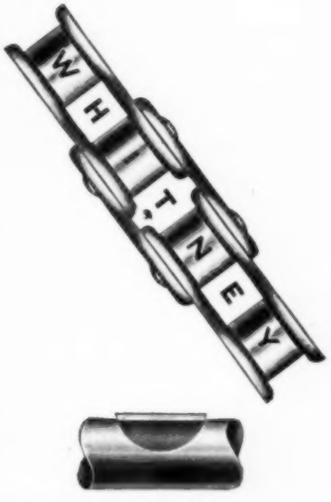


Latest Improved "Whitney" CHAIN BELT is a great success for many purposes.



This New Vertical Universal High Speed Milling Attachment makes the "Whitney" Hand Miller one of the most complete and desirable tools on the market for a wide range of work.





If you are not taking advantage of the Woodruff Patent System of Keying it will pay you to investigate. Better results and greater saving in cost. We carry 95 regular sizes of Keys and Cutters in stock for immediate delivery.

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HARTFORD, CONN.

Chucks, Lathe —*Continued.*

Russell Anti-friction Drill Chuck Co., Elmira, N. Y.
Skinner Chuck Co., New Britain, Conn.
Union Mfg. Co., New Britain, Conn.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer

Cincinnati Planer Co., Cincinnati, O.
Harrington & Son Co., Edwin, Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Union Mfg. Co., New Britain, Conn.

Chucks, Split

Hardinge Bros., Chicago, Ill.
Rivett Lathe Mfg. Co., Boston, Mass.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.

Circuit Breakers

Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Clamps

Hammacher, Schlemmer & Co., New York.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Starrett Co., L. S., Athol, Mass.
Tudor Mfg. Co., Taunton, Mass.

Clocks, Watchman's

Hardinge Bros., Chicago, Ill.

Clutches, Friction

Bliss Co., E. W., Brooklyn, N. Y.
Caldwell, Son & Co., H. W., Chicago, Ill.
Eastern Machinery Co., New Haven, Conn.
Evans Friction Cone Co., Newton Centre, Mass.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Oesterlein Mach. Co., Cincinnati, Ohio.
Reeves Pulley Co., Columbus, Ind.
Williams Foundry & Machine Co., Akron, Ohio.

Coal Handling Machinery

Link-Belt Co., Philadelphia, Pa.

Compound, Core

Obermayer Co., S., Cincinnati, O.
Universal Fluxine Co., Urbana, O.

Compound, Pipe Joint

Dixon Crucible Co., Joseph, Jersey City, N. J.
Smooth-On Mfg. Co., Jersey City, N. J.

Compressors, Air

Blaisdell Machinery Co., Bradford Pa.
Bury Compressor Co., Erie, Pa.
Clayton Air Compressor Works, New York.
Independent Pneumatic Tool Co. Chicago, Ill.
Ingersoll-Rand Co., New York.
Spacke Machine Co., F. W., Indianapolis, Ind.

Compressors, Gas

Blaisdell Machinery Co., Bradford, Pa.
Ingersoll-Rand Co., New York.

Cones, Friction

Evans Friction Cone Co., Newton Centre, Mass.

Connecting Rods and Straps

Electric Welding Products Co., Cleveland, Ohio.
Standard Connecting Rod Co., Beaver Falls, Pa.

Contract Work

Blanchard Machine Co., Cambridge, Mass.
Cell Drier Mach. Co., Taunton, Mass.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Fuller Mfg. Co., New Haven, Conn.
Merritt, Jos., Hartford, Conn.
Morrow Mfg. Co., Elmira, N. Y.
Owen Machine Tool Co., Springfield, O.

Contract Work—*Continued.*

Schaeffer Mach. Wks., Phila., Pa.
Turner Mach. Co., Danbury, Conn.

Controllers and Starters, Electric

Crocker-Wheeler Co., Ampere, N. J.
Cushman Electric Co., Concord, N. H.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Conveyors, Automatic

Lamson Consolidated Store Service Co., Boston, Mass.
Link-Belt Co., Philadelphia, Pa.

Coping Machines

Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Corundum

See Grinding Wheels.

Cotters

Cleveland Twist Drill Co., Cleveland, Ohio.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores

Cleveland Twist Drill Co., Cleveland, Ohio.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Counters, Revolution

Root Co., C. J., Bristol, Conn.
Schuchardt & Schutte, New York.
Veeder Mfg. Co., Hartford, Conn.

Countershafts

Almond Mfg. Co., T. R., Ashburnham, Mass.
Builders Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co. Worcester, Mass.
Dill Slotter People, Phila., Pa.
Evans Friction Cone Co., Newton Centre, Mass.
Garvin Mach. Co., New York.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Norton Grinding Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Smith Countershaft Co., Boston, Mass.

Countershafts, Friction

Dill Slotter People, Phila., Pa.
Evans Friction Cone Co., Newton Centre, Mass
Wilmarth & Mormon Co., Grand Rapids, Mich.

Counting and Printing Wheels

Franklin Mfg. Co., H. H., Syracuse, N. Y.

Couplers, Hose

Greene, Tweed & Co., New York.
Independent Pneu. Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.

Couplings

Almond Mfg. Co., T. R., Ashburnham, Mass.
Caldwell & Son Co., H. W., Chicago, Ill.
Davis Machine Co., W. P., Rochester, N. Y.
Link-Belt Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Williams Fdry. & Mach. Co., Akron, Ohio.

Cranes

Brown Hoisting Mach. Co., Cleveland, O.
Case Mfg. Co., Columbus, O.
Cleveland Crane & Engineering Co., Wickliffe, Ohio.
Manning, Maxwell & Moore, Inc., New York.
Maris Bros., Philadelphia, Pa.
Nicholls, Wm. S., New York.
Niles-Bement-Pond Co., New York
Northern Engineering Works, Detroit, Mich.

Cranes —*Continued.*

Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Crank Pin Turning Machines

Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts

Standard Connecting Rod Co., Beaver Falls, Pa.

Crucibles

Dixon Crucible Co., Joseph, Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Crushers

Farrel Fdry. & Mach. Co., Ansonia, Conn.
Niles-Bement-Pond Co., New York.
Link-Belt Co., Philadelphia, Pa.

Cupolas and Ladles, Foundry

Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.

Cups, Grease

Lunkenheimer Co., Cincinnati, O.

Cutters, Milling

Adams Co., Dubuque, Iowa.
Becker Milling Machine Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hardinge Bros., Chicago, Ill.
Harrison & Knight Mfg. Co., Newark, N. J
Ingersoll Milling Mach. Co., Rockford, Ill.
Kearney & Trecker, Milwaukee, Wis.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Ward & Son, Edgar T., Boston, Mass.
Whitney Mfg. Co., Hartford, Conn.

Cutting-Off Machines

Armstrong Bros. Tool Co., Chicago Ill.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I
Davis Machine Co., W. P., Rochester, N. Y
Hurlburt-Rogers Mach. Co., South Sudbury, Mass.
McCabe, J. J., New York.
Newton Mach. Tool Works, Inc., Philadelphia, Pa
Pratt & Whitney Co., Hartford, Conn
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Cutting-Off Tools

Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn
Cleveland Twist Drill Co., Cleveland, O.
Fitchburg Machine Works, Fitchburg, Mass.
Krieger Tool & Mfg. Co., Chicago, Ill.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Diamond Tools

Abrasive Metal Co., Phila., Pa.
American Emery Wheel Co., Providence, R. I.
Dickinson, Thos. L., New York.
Safety Emery Wheel Co., Springfield, O

Dies, Sheet Metal

American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.

Dies, Sheet Metal —*Continued.*

Boston Tool Co., Cambridge, Mass.
Consolidated Press and Tool Co., Hastings, Mich.
Ferracute Mach. Co., Bridgeton, N. J.
Stearns Stamping Co., W. H., Worcester, Mass.

Dies, Sub-Press

Sloan & Chace Mfg. Co., Newark N. J.
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening

Boker & Co., Hermann, New York.
Errington, F. A., New York.
Foote-Burt Co., Cleveland, O.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Machine Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.

Drawing Boards and Tables

Kolesch & Co., New York.

Drawing Materials

Kolesch & Co., New York.

Drafting Machines

Universal Drafting Mach. Co., Cleveland, O.

Drilling Machines, Bench

American Watch Tool Co., Waltham, Mass.
Barnes Co., W. F. & John, Rockford, Ill.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.
Rockford Drilling Mach. Co., Rockford, Ill.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Boiler

American Tool Works Co., Cin., O.
Bickford Drill & Tool Co., Cincinnati, O.
Foote-Burt Co., The, Cleveland, O.
Ingersoll-Rand Co., New York.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Sellers & Co., Inc., Wm., Phila., Pa.

Drilling Machines, Multiple Spindle

American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Flather Planer Co., Mark, Nashua, N. H.
Foote-Burt Co., The, Cleveland, Ohio.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelbhia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Natiodol Machine Co., Hartford, Conn.
Newton Mach. Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Slate Mach. Co., Dwight, Hartford, Conn.
Taylor & Fenn Co., Hartford, Conn.

Drilling Machines, Portable

Cincinnati Elec. Tool Co., Cin., O.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Hisey-Wolf Mach. Co., Cin., O.
Ingersoll-Rand Co., New York.
Newton Machine Tool Wks., Inc., Phila., Pa.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O.

No. 3 PLAIN MILLING MACHINE. WORKMANSHIP AND ACCURACY GUARANTEED TO HENDEY STANDARDS.

This machine has 21 changes of feeds through gearing and driven by heavy roller chain.

Table, Cross, and Vertical Feeds ALL AUTOMATIC. Ball Bearing Thrusts on elevating and table feed screws.

Each feed has separate engagement, and with feed reverse are within easy control from front of knee.

Table has working surface of 48.5" x 13", and 3 T slots $\frac{5}{8}$" wide. Range of feeds 34" x 10" x 20".

Main Spindle has Taper Journals at either end, running in Annular Bearings, fitted with Ring Oilers. The best spindle construction used as it affords longest possible wear and maintains accuracy of alignment.

Top Housings for Arm are ANNULAR and fitted with self-centering Binders.

The Hendey Machine Co.,
Torrington, Conn., U. S. A.

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welding in France most of the members of this society will remember the frame used by the Darracq Company several years ago. The whole frame, apparently, was pressed out of one piece. The engine and the transmission cases were supported by extensions of the bottom flange of the frame, but this supporting pan was solid at some parts with the upper flange and must have been welded. This condition was a veritable Chinese puzzle to the majority of people in this country at that time, as the possibilities of oxy-acetylene welding were not then generally known.

Investigations have proved that it is possible to autogenously weld without materially changing the composition, and also that there is no more carbonization due to the use of acetylene than there is with the hydrogen flame.

Welding Steel

Steel does not become so fluid as the majority of metals, and can therefore be worked in any position. It is possible to weld on the under side, particularly where the high-pressure torch is used, as the high pressure spreads the metal, thus making it possible to weld an automobile frame in place and even add metal to the under side of the upper flange, or to the lower side of the bottom flange as well as to the vertical web.

When adding metal, care should be taken not to let the full force of the flame play on the rod, unless it is in contact with the larger body of metal being welded, which will absorb the surplus heat and prevent it being burned.

As in blacksmiths' welding, the amount of carbon has a good deal to do with the strength of the resulting weld. High-carbon steels do not always prove satisfactory, but high-speed steel can be welded to machine steel without any trouble. This feature should prove interesting to superintendents, as considerable reduction in the amount of high-speed steel required should result by its use.

Broken crank shafts have occasionally been welded, though I do not recommend this unless it is in the web where a large amount of metal can be added, or at the end of a bearing where it can be left large and the bearing correspondingly shortened. This, however, is advisable only in cases where it is difficult to get a replacement.

There is an enormous benefit to be derived from the use of this process to eliminate defects which seem bound to appear in steel castings. The success with which steel castings can be welded depends largely on the nature of the metal and this would, of course, determine the extent to which the welding process could be used.

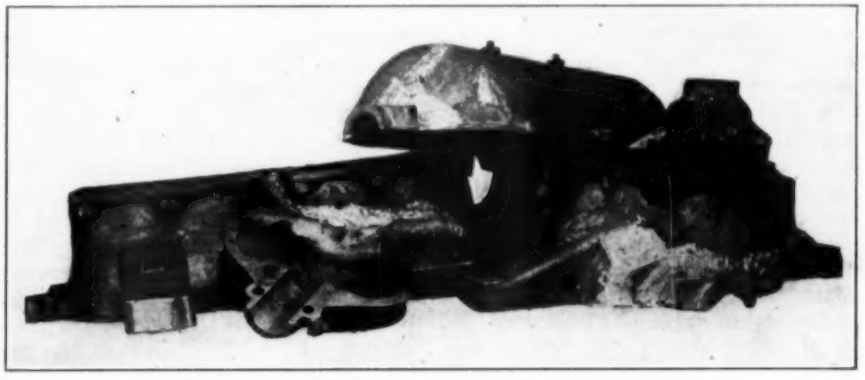


FIG. 9. WELDING ALUMINUM

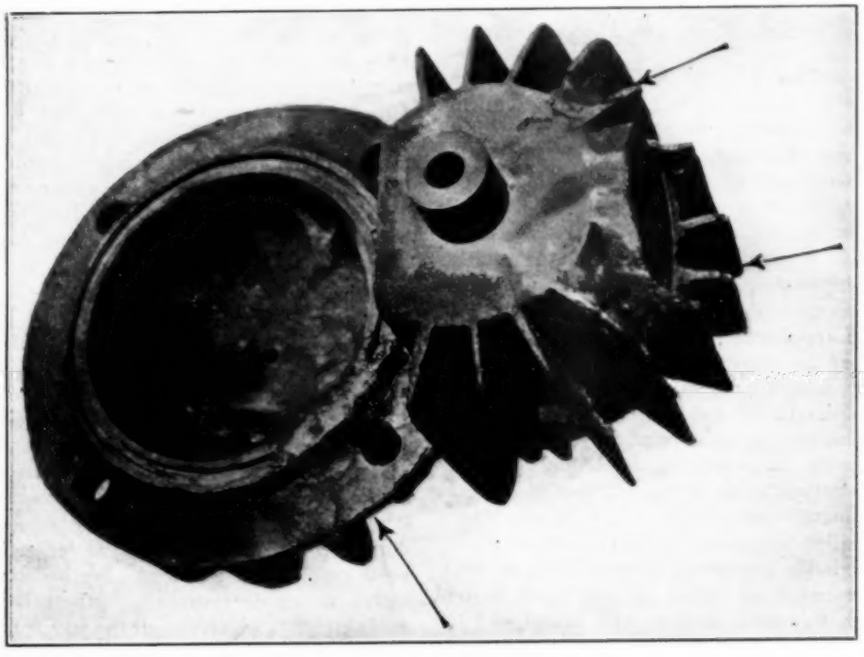


FIG. 8. WELDING CAST IRON

Commercial soft-steel wire is used as a filler in most cases, but sometimes it is desirable to use pieces from a similar casting and these can readily be cut into strips by the oxygen cutting torch. It is advisable, where possible, to test sample welds where the best combination is not known.

Welding Cast Iron

The welding of cast iron is really the most satisfactory of all metals, as the metal becomes sufficiently fluid to leave a smooth surface. In a molten state the metal flows very much like mercury, that is, it hangs together in balls. These balls have to be broken up by what is termed scaling powder which is used in much the same manner as a flux in brazing. Salt can be used for this purpose, though it is liable to harden the metal. The Davis-Bournonville Company has a powder on the market which is not attended with this disadvantage, the composition of which is somewhat of a trade secret, though the price at which it sells is so low as to make it not worth while trying to imitate it.

Considerable care has to be exercised as to the nature of the filling stick used, as iron containing scrap will often cause trouble by hardening. It is, however, no trouble to obtain soft welds when care is taken in selecting this material. Care should also be taken not to overheat the metal and also to allow it to cool off slowly.

Intricate castings should be preheated all over to several hundred degrees, though not enough to cause serious warping, to reduce the possibility of shrinkage cracks, which might otherwise take place due to the extreme difference in temperature at different parts of the casting. Foreign automobile cylinder castings are particularly liable to this, possibly owing to the large percentage of sulphur which produces hot shortness.

Cast iron has the peculiarity of flowing to the part having the highest temperature; it is, therefore necessary, when wishing to draw metal from one part to another,

to play the torch on the latter place, but of course keeping the other one molten.

The operator is aware of the blow holes he leaves in the weld, as the metal will not flow over these without special effort on his part, the hole showing as a depression in the surface which must be blown open with the flame so as to close from the bottom, or as is often the case when it is due to sand or slag, it must be dug out with an iron rod to be eliminated. The special effort required to close over this depression consists of playing the torch in a circle around the depression and then suddenly removing it. The momentum of the metal causes it to unite over the cavity. The desirability of doing this is, of course, determined by the requirements of the piece being welded.

A good illustration of what can be accomplished in cast iron with this process is seen in Fig. 8, which shows a 12-horsepower racing motorcycle combustion chamber, the welding on which was carried out at the plant of the Autogenous Welding Equipment Company, Springfield, Mass.

The broken flange was welded up, and metal added around the exhaust boss, which had been opened up for racing so that there was not sufficient metal left to support the exhaust pipe when it was required to attach one.

Welding Aluminum

Possibly the most radical development which this process has produced is the satisfactory welding of aluminum. This has long defied all attempts to unite it in a manner that would withstand a strain anything like the metal itself. It is due to the reducing nature of the flame, which is not sufficient to cause the metal to flow together. The actual uniting is produced by puddling the molten metal with a steel rod which effectually breaks up any coating of oxide. In the same manner bosses and other additions can be added to castings, they being shaped up in much the same manner as one might do with molding sand. The molten metal works in much the same manner as this sand.

Great care has to be taken in handling this metal owing to it having very little strength when heated a few hundred degrees, and this difficulty is increased by its high heat conductivity which allows very little difference in temperature between the place being welded and the surrounding metal. This is, however, taken care of by supporting the metal on the other side with graphite blocks.

Notwithstanding these difficulties very successful work is being carried out in this metal. Large castings that look more fit for the scrap heap are made serviceable again as can be seen by crank cases shown in Fig. 9. On these there is a total of about seven feet of welding. In one case the bearing was broken so that it was not worth while to repair it, and a casting was obtained from the broken part which was welded on.

Owing to the fine adjustment of the gases obtained in the high-pressure torch the temperature of the flame can be somewhat reduced, which facilitates the welding of aluminum.

When casting any metal which is not ductile, there is more or less trouble with shrinkage cracks, and, of course, this is also the case with welding, and though shrinkage cracks can be welded up, in some cases they are produced, as can be realized when it is considered that very often the metal is already taxed to the limit by the internal strains, and the extra strain, produced by heat, or else the weakening of the metal by its application proves to be the last straw. This can be well understood by those who have had experience in soldering aluminum, as the small heat required for the purpose is sometimes sufficient to produce a crack.

This is obviated to a great extent by heating the whole casting uniformly, thus reducing the difference of temperature between the part being welded and the body of the metal. However, the great majority of breakages consist of lugs and arms broken off entirely and there is seldom trouble of the above nature in their repair.

Welding Brass and Malleable Iron

Brass is more difficult to work than most metals and requires more experience on account of the zinc readily burning out and depositing a yellow powder on the weld, and also leaving blow holes. It is advisable to use borax to prevent this deposit. It is necessary to get the metal to a good red heat and then quickly bring the welding flame down on it, and as quickly removing it as each drop flows. Care should be taken not to breathe much of the fumes from the zinc.

Malleable iron is a very unsatisfactory material to weld owing to its variation between what is practically cast iron and what is practically steel, and on thick castings often a combination of both. In most cases cast iron can be used as a filler, but, of course, this is not always advisable owing to its unsuitability to withstand shock. Steel can, of course, be used but does not work so well, except with the kind of malleable iron that is practically steel.

The automobile manufacturer would, however, mainly use the torch on this material to fill blow holes, weld up shrinkage cracks and to add metal to replace errors in workmanship, and in most cases cast iron would be satisfactory for these.

Combinations of Metals

With this process it is possible to unite different metals, those having the nearest fusion temperatures, of course, being most practical. So far, there is very little use for such combinations. The most useful combination, however, is copper and steel; these metals mix in such a manner that it is impossible to say where one commences and the other ends. This is of great advantage for electric conductors, as there is no possibility of oxidation taking place between them and reducing their conductivity.

This has been taken advantage of by the Davis-Bournonville Company in its patent electric rail bond, and ought to prove of use in electric vehicles.

Cast iron and steel can be satisfactorily united, and I believe there is a big future in this for internal-combustion engine exhaust valves, as the desirability of having cast-iron exhaust valve heads has been generally acknowledged, but its adoption has been prevented by the difficulty of satisfactorily attaching the steel stem.

Repairing Cracked Seamless Cast-iron Steam Jackets

By Wm. H. Dopp

When my father, the late H. Wm. Dopp, first began the manufacture of his seamless cast-iron steam-jacketed kettles he was much troubled by shrinkage cracks in the outer shell. These cracks were due to the use of too hard a jacket core, and presented so serious a problem (till he had succeeded in educating his foundry to make a proper core) that it became the alternative to utilize these defective castings or give up the enterprise. To meet this condition he devised the herein described method of closing the cracks, and as the method proved very successful for the repair of kettles that had been damaged by water freezing in the jacket, it may prove of interest to the readers of the American Machinist, and be applicable to other lines of work.

There are many thousands of these kettles in use throughout the country, and as long as there are leaky steam valves and careless men who forget to see to it that the drip cock to the jacket is open during cold weather, every winter will see a crop of burst jackets. We had occasion to repair many after others had made attempts which ran all the way from efforts to solder up the cracks to bolting on a saucer-shaped shell weighing one-fourth as much as the kettle, but in no instance was there even partial success.

A glance at the accompanying illustration will show the construction of these kettles. They are cast in one piece, the inner and outer shell being connected by a number of stays *S, S*, ¼x1¼ inches section, spaced about 4 inches centers. We successfully repaired kettles in which as many as twelve or more stays had been torn off, and in which the cracks extended fully three-fourths the way around the kettle.

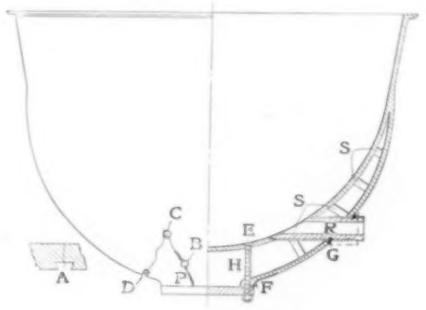
We proceeded as follows: In the first place by light taps of an ordinary machinist's hammer, delivered carefully along the various cracks we forced the pieces as far as possible into their original position. We next drilled a number of holes along the cracks with their centers in the cracks and spaced about 4 inches apart. These holes were drilled right through both shells, and care was taken to have a hole at each end of a crack to prevent its extension farther. These holes were next countersunk both on the inner and outer shell. Through as many of these holes as was found necessary, machine bolts, with rather large washers were put in. These bolts were drawn down as tightly as possible so as to bring the loose pieces as nearly down to a solid bearing as was possible, and to force the edges of the cracks closely together. A stay-bolt tap was now run through the holes unoccupied by bolts, care being taken that there was a full thread in the holes in both the shells. We commonly used 5/8-inch stay bolts, but at times 3/4-inch. An ordinary bar-iron stay bolt was now screwed in, but not only was care taken that it had a full clean thread, but after the oil had been carefully wiped off, it was dipped in a strong solution of sal ammoniac to which some raw muriatic acid had been added so as to insure a rust joint between the shells and the bolt. After cutting off the surplus length at both ends the bolt was riveted till it filled the countersink. On the inner shell the bolts were always trimmed down so as to leave a smooth surface on the outer shell; this was only done when a show job was desired. The machine bolts were now removed, and replaced by stay bolts after tapping the holes. We now have the pieces firmly back into place and securely bolted and riveted to the solid and uninjured inner shell. So far nothing is required except what any ordinary skilled mechanic can do. The next step, however, should be attempted only by one thoroughly master of the use of hammer and chisel. With a narrow cape chisel a narrow dovetail groove about 1/16 to 3/32 inch deep and 3/16 to 7/32 inch broad is next cut, carefully following the cracks, as shown at *D* and *A*. These grooves were cut part way into the heads of the bolts, as at *B*.

Next copper strips of proper thickness were carefully annealed and inserted into these groves. With a light peen-hammer these copper strips are now peened down to fill the grooves, the peening being followed by a flat calking tool. The surplus copper is nicely trimmed off and the job is done.

We subjected these repaired kettles to 100 pounds only cold-water pressure, whereas we subjected new kettles to 130 pounds to 140 pounds cold-water pressure. We guaranteed repaired kettles safe with 60 to 65 pounds steam pressure, which is ample for most purposes. When the cracks were extensive we usually put a ring of stay bolts around the opening left by the coreprint and closed by a blind flange. As shown at *H*, we left these bolts long enough to take a nut to bolt down the flange.

At *E* is shown the countersunk head on the inner shell, at *P* and *F* the copper insert, while *C* illustrates the stay bolt at the end of a crack to prevent farther extension of same.

At *R* is shown the application of the same principle to making a joint. We were to furnish a kettle with a horizontal 1½-inch outlet so placed as to empty the kettle to within 3 inches of the bottom. Ordinarily we would have cast a special kettle with a boss as indicated by the dotted line, but as we were driven by orders and had a kettle of the required size in stock, we determined to risk failure, especially as the particular size was at times a very slow seller. We first drilled a hole through both shells, and with a portable boring and thread-cutting



REPAIRING CRACKED KETTLES

machine we enlarged these holes and cut a continuous thread, or rather what would have been a continuous thread had there been stock. Not only did we pass through the empty steam space, but not a single thread in either shell was of a full circumference in length. We next turned up a sleeve 1½-inch bore and about 2½-inch outside diameter of as soft cast iron as we could procure. A continuous thread was cut on this sleeve and it was screwed into place so that the proper bevel of the inner end could be marked. It was removed and cut, leaving about ¼ inch excess stock. The hole in the inner shell was chamfered or countersunk by means of a chisel and file. The sleeve, after being moistened with a solution of sal ammoniac and muriatic acid, was screwed into place. With a light cross-peen hammer, followed by a flat calker the end of the sleeve was spread until it filled the chamfer of the hole, and was so nicely trimmed that it was impossible to see the joint. At the outside shell a dovetail groove was cut, partly in the sleeve and partly in the shell. Now a copper insert *G* was calked in. To make sure of a tight job we tested with 160 pounds cold-water pressure.

We used the same method in repairing steam pipes that had been damaged by water freezing in them. In this case we first closed the cracks or splits as far as possible, by peening before cutting the groove. This repairing can frequently be done without removing the coils from their places. We used a steam radiator for over 15 years, that had been thrown onto the junk heap as useless, after spending a little over a half-day's work in repairing it by this method. If, however, this method is to be employed to repair large pipes subjected to pressure, I would recommend putting a stay bolt at the ends of the crack through to the other side. Then wind the pipe with galvanized wire after the manner of wire-wound guns. This wire should be wound on with considerable tension, and should extend about one-third the length of the crack or split beyond either end thereof. Five or six convolutions at each end should be soldered in the manner of dynamo armatures.

This method of repairing damaged steam apparatus is efficient, but I have never seen it used by anyone else.

Use of Nickel Steel in Bridge Building

In an interesting paper read before the American Society of Civil Engineers, J. A. Waddell contributed some valuable material to the prominent subject of using nickel steel in bridge building. Summarizing from the results of his experiments, covering a period of five years, he pointed out that nickel steel is in every way fitted for bridge construction, in that it is strong, tough, workable and reliable; moreover, its adoption would effect a decided economy. This economy would increase in the future as the cost of nickel decreases, and as the shops become more accustomed to the treatment and handling of the new alloy. That nickel will soon be less expensive is almost a foregone conclusion, in view of the enormous deposits of nickel that have been found in existence in Canada. It is stated on good authority that there has been found in one deposit in that country ore containing fully 200,000 tons of the metal, and the outlook for an enormous supply is bright.

A fact that seems to have been established with reference to the relative cost of operating steam and electric locomotives is that it takes 30,000 miles of running to wear down the tires of an electric locomotive 1/32 of an inch, whereas under exactly similar conditions the same amount of wear takes place in from 8000 to 9000 miles of running on a steam locomotive.

A Large Disk Grinder

This is, perhaps, the largest disk grinder made, the disk or web being 6 feet 9 inches outside, and the outer edge of the emery ring just 6 feet in diameter. This gives practically the same speed at all parts of the grinding surface, and about 18 square feet of abrasive, counting both sides, to work on. When dull it can be trued up with any kind of a wheel dresser.

These grinders have been at work in the builder's own shop for over two years,

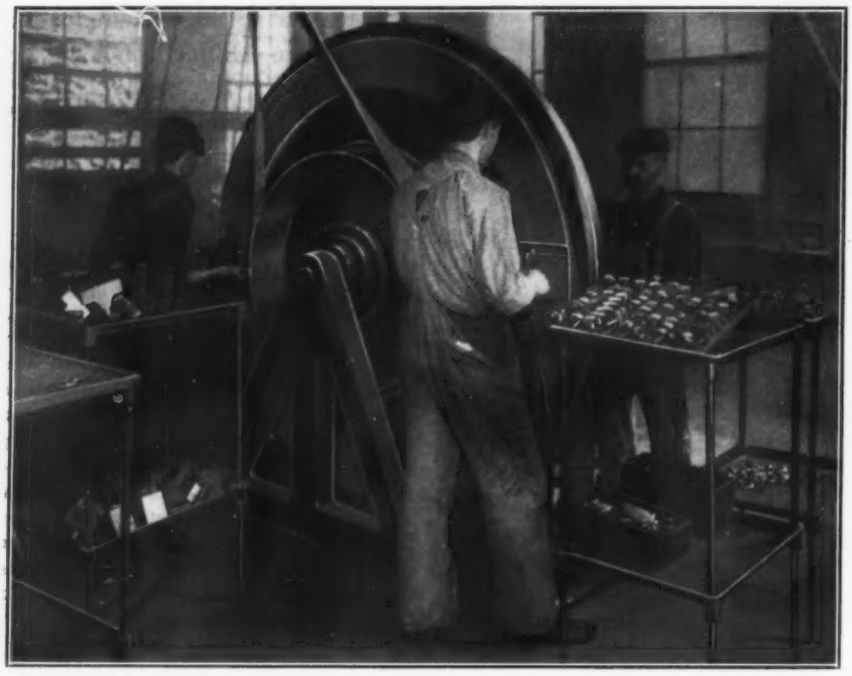


FIG. 1. A LARGE DISK GRINDER

runs on Timken roller bearings, adjusted to insure rigidity in each direction. There are nine specially molded abrasive blocks on each side of the disk, 8 inches wide and 4 inches thick, fitting each other at an angle so as to avoid a square joint. This and the abrasive blocks are regularly worn down to ½ inch in thickness by packing out with wooden strips. As can be seen in the detail sketch, the blocks are held in place by clamps acting on lead strips and they are held at many points, on each side of the block; it makes a very safe fastening.

The wheel center is at a convenient hight, which makes it possible to work four men at each wheel, as seen in Fig. 1. They have been used very successfully to grind high-speed steel, at a speed of about a mile a minute, a 6-inch belt on a 36-inch pulley being used. They are made by the O. K. Tool Holder Company, Shelton, Conn.

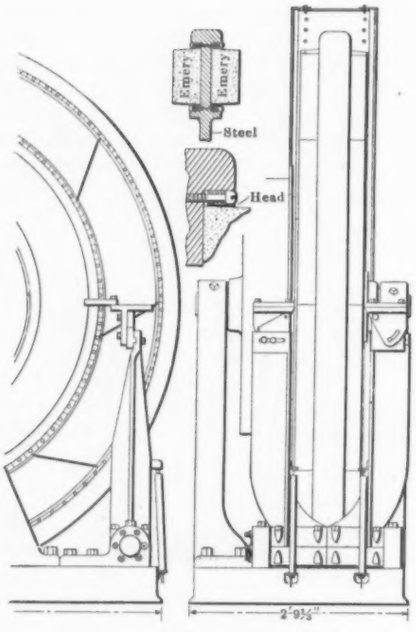
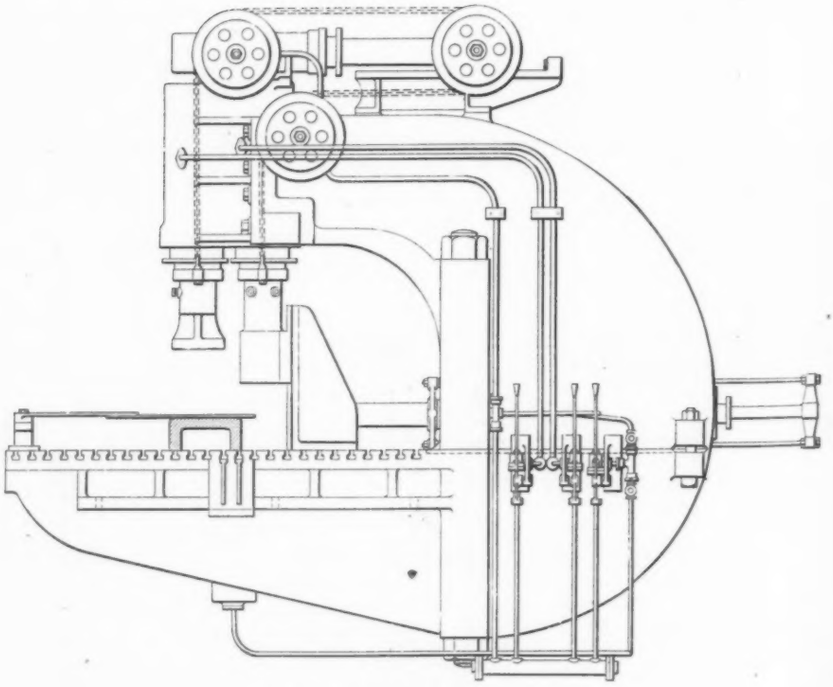


FIG. 2. DETAILS OF DISK GRINDER

A Large Sectional Flanging Press

This is designed for the flanging of very large sheets which have to be done in sections and have a total capacity in the gap, counting from the outer end of the flanging table of 10 feet 6 inches. There are two vertical rams, as shown, the front being usually employed to hold the sheet against the form while the rear plunger does the flanging.

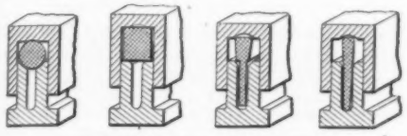
There is also a ram below the center of the table half way between the two upper rams which can be used in double flanging, such as locomotive firebox back sheets where the flanges for the shell and fire-door are turned in opposite directions, and a horizontal ram for side flanging. The cylinders have 30-inch stroke with 1500 pounds pressure per square inch and 13½ inches in diameter. The capacity of the press is 200 tons. It is built by William H. Wood, Media, Penn.



A 200-TON SECTIONAL FLANGING PRESS

Tait Universal Tool Holder

This tool holder consists of two parts, a base in the form of an inserted T and having a slot in the center of the web. Over this is a cover which may be likened to a channel iron and the various tools are held between the two, as shown in the illustrations.



TAIT UNIVERSAL TOOL HOLDER

These show some of the shapes that can be readily and firmly held, and include the round boring tool, any large square-shanked tool, or parting tools of the narrow type, as shown. The whole thing is slipped through the ordinary tool post, or can be held in any type that may be used. This is made by the Van Doren Manufacturing Company, 89 West Jackson boulevard, Chicago, Ill.

Some Essentials of True Leadership

By Philip Bellows

There are two distinct types of men to be found at the top of most industrial enterprises. The fact that is most evident in the relationship of the man to his position is, in the case of one type, that he is always bigger than his job and of the other that he is always smaller than his job. Now the enterprise that is ruled by a man of the second type invariably has to get rid of its leader, or go to the wall. So long as he directs its affairs he will, by his methods, or lack of the same, be continually choking the life of the concern.

In no respect is a man's unfitness to manage large affairs more easily detected than in his attitude toward his assistants. If he is conscious of a lack in himself of any qualification necessary to success he is probably at the same time so full of egotism that he would rather allow the business to suffer detriment and loss, than permit a subordinate to supply his deficiencies. A man of this type often parts with those around him who are best fitted to aid him in conducting successfully the enterprise and fills their places with inferior material; choosing men who are as far behind in their qualifications for success as he is himself. If he does not actually lose his best men he will, by his attitude and conduct toward them make it impossible that their ability and fitness be used to the fullest extent.

Recognizing Talent in Others

The greatest leaders of men, and this is true, I believe, in every line of human endeavor, have always been those who could detect, most readily, latent talent in others and turn it to their own profit. The unsuccessful leaders have in the majority of cases been those who, besides lacking sufficient foresight to be able to lay out their plans for the morrow, next month, or next year, lacked also sufficient insight to enable them to select from the men around them those best fitted by nature, talent, experience and temperament to assist them as leaders among the forces which they controlled. The key to success in leadership lies in the capacity of the leader to make his lieutenants and sub-lieutenants, representatives of himself to the division of the army of workers each controls. Therefore, the man who lacks foresight and insight can never be a leader no matter how great his other mental characteristics may be. It is for this reason that so many meritorious inventions have come to nothing and been lost to the world, because the inventor was chosen as the leader in the business of putting his invention on the market. It is in the nature of things for the inventor to be so absorbed in his invention that he cannot devote his mind sufficiently to looking ahead and providing for many factors necessary to the success of the enterprise. Furthermore, the close application on his part to the one idea and its development and ultimate fruition have, unavoidably, deprived him of the opportunities to study men, and without this study his insight into their qualifications will never be developed. For it is only through personal experience that we can get such knowledge.

Unless his assistants have faith in him and in his possession of these two qualifications, the cohesion and unity of action necessary to the successful operation of any machine or enterprise will be lacking, and no matter how strong the edifice may be upon which he rests, his deficiency will prove a disintegrating force. If you go through the plant of a successful enterprise you will generally notice that, no matter how great the difference in type between the head and his corps of assistants, each one has been chosen for some special qualification that made him just the right man for his particular place. Enter, on the contrary, a plant where every position of any consequence seems to be filled by the proverbial round peg in a square hole and you may know at once that the leader is no leader at all, but a figure head, and no matter how great its past record, unless a radical change is made, ultimate disaster will overtake that concern.

From Inspector to Manager

An incident in the history of a man who is now the operating head of the world's largest locomotive shops, comes to my mind. It occurred in these same shops, but when he was there as an inspector representing one of the country's greatest railroads. A dispute arose between himself and the superintendent of the erecting shop over a cylinder casting, which the cylinder gang was about to build into one of his engines. He saw that the casting was defective, and though the defect was so slight as to be apparently unimportant, he was too keen to allow it to pass. The superintendent argued for putting the cylinder in; the inspector stood for keeping it out. However, the dispute had not gone far when he seized a sledge hammer which lay at hand and swung it with all his might upon the weak spot in the casting. The dispute was ended by the simple process of despatching the cause of it to the scrap heap. Shortly after this a representative of the locomotive company came to him and offered him a berth.

Someone with the foresight of a true leader had realized that with such a man at large in the locomotive world it was impossible to tell whether it would be cylinders, or their whole business, that might next be demolished. It was safer to get him roped in.

He is now the operating head of the company, and one of its directors. Aided by his energy and ability that great concern has grown until now, if I am correctly informed, its output about equals that of all other private locomotive shops in America.

From Draftsman to Superintendent

Another incident in connection with the same great leader which is just as characteristic of the man, illustrates another point. One of the designers had made a bad record for himself as the author of many mistakes which had gone out into the shops and caused trouble. Sammy was the name by which he went, and all who knew his work felt that the time was fast approaching when Sammy would be requested to leave them. It should be stated, that along with his faculty for getting himself into trouble went a wonderful ability for getting out again. For whenever one of his mistakes was located he showed a perfect genius for correcting the error with minimum delay, and many of his achievements in this line were a source of wonder to his comrades. At last the crisis came; a blunder or omission which could not be overlooked was the cause one day of a visit on Sammy's part to the office of the superintendent, our whilom locomotive inspector. What was the astonishment in the drawing office when it was announced that Sammy was slated for promotion instead of discharge! I have forgotten the exact position into which he was put, but it was near to the head of the repair department. The superintendent had observed something that no one else, not even Sammy himself, had noticed. He was placed wrongly; in his right place he might be one of the most useful men in the employ of that great concern. His

ability to repair his own mistakes was henceforth to be utilized in repairing the mistakes of others. Thus we see how the true leader could discern the qualifications for successful lieutenantship where another would see only incompetence and failure.

In the other instance, the man who, when he heard of the unexpected and unusual course taken by the obscure locomotive inspector, detected in it something more than an outburst of temper and was able to perceive the peculiar fitness for responsibility of such a man, must have been himself a great leader; big enough in every way to discover and be willing to acknowledge the same qualities in another and turn them speedily to account.

An Unusual Crane Girder Design

By D. S. Barrow

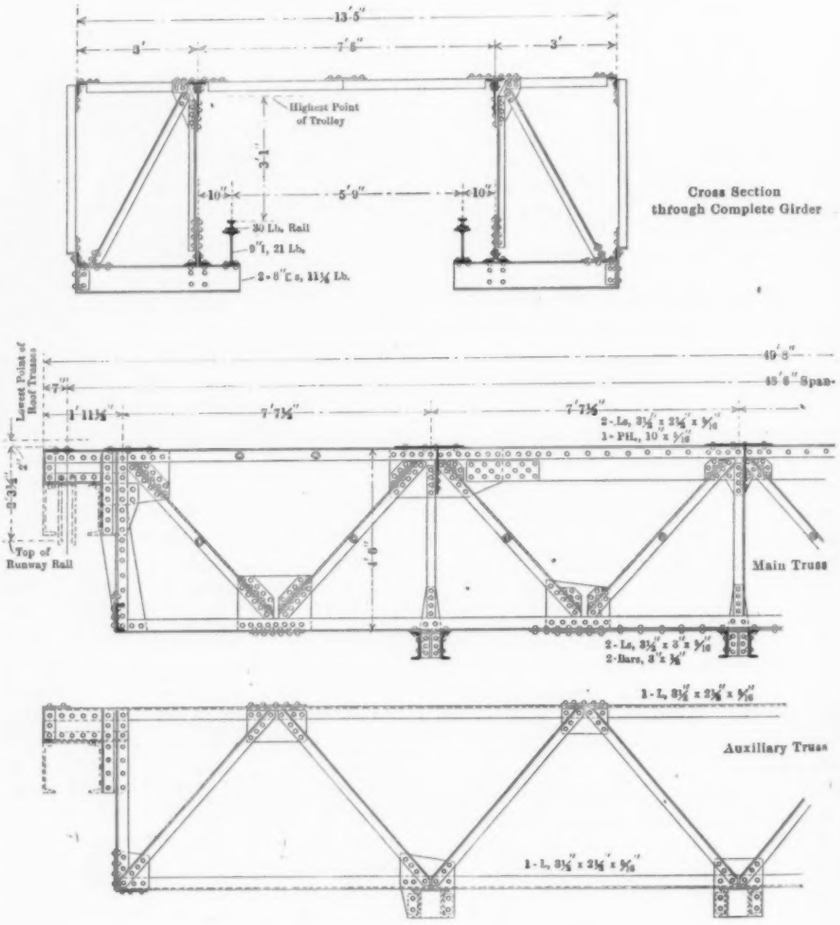
The crane girders shown in the accompanying drawings were designed by me to meet unusual conditions, and it is believed that certain features are novel. The clearance between the top of runway rail and the under side of the roof trusses was so small as to prevent the use of the usual end truck connections, even with a standard trolley.

The specifications required that all motors should be capable of handling the maximum load at full speed for a period of two hours without exceeding a certain very low temperature rise. This necessitated the use of motors several sizes larger than the ordinary and made a very bulky trolley.

I have never been in favor of the submerged type of trolley running on the lower flanges of plate girders, because of the local bending and twisting moments which this produces, and the inaccessibility of the working parts. In the present case the great depth required would have made such a design uneconomical as to material, and the necessity for carrying channels or other suitable members across the tops of both girders to resist the lateral load through inclined struts would have lowered the trolley about 10 inches. Furthermore, our standard trolley had bearings on each side of the track wheels, which would have prevented its use in this type of girder.

The rails for the trolley were attached by hook-bolts to the top flanges of 9-inch beams, which in turn rested on the cantilevered ends of 8-inch channels suspended in pairs from the main trusses, the outer ends being supported by the auxiliary trusses. All details were worked out so that no rivets should be in tension. Each main truss was connected to its auxiliary by a bottom lateral system, of which the 8-inch channels formed the struts, interior diagonal bracing, and a top lateral system. Lateral braces also connected the top chords of both main trusses.

It will be noted that the cover plates on the bottom chords of the main trusses were divided to allow attachment of the connection plates from the cantilevered channels direct to the vertical ties. These ties might have been eliminated by supporting the 8-inch channels from the lower panel points rather than the upper ones, but this would have required extending the main gusset plates through, and biting out the corners so as to pass between the channels. It would also have interfered with the bottom lateral system.



AN UNUSUAL CRANE GIRDER DESIGN

The design shown is not by any means the only way of getting around the difficulties the conditions raised, and is perhaps not the best one, but the reasons which dictated its adoption were deemed at the time to be sound.

The new customs tariff for Denmark which went into effect on January 1, 1909, makes considerable changes from the existing duties and it is noted that in electrical machinery there is a reduction from 10 to 7½ per cent. ad valorem and in other machinery not specifically tariffed the reduction ranges from 10 to 5 per cent.

Business Items

The Potter & Johnston Machine Company, Pawtucket, R. I., is very busy on its line of manufacturing automatics, and has an addition of 12,000 square feet now in course of construction to take care of their increased business.

The Youngstown plant of the Republic Iron and Steel Company has equipped its spike department with the fuel oil system manufactured by Tate, Jones & Co., Pittsburg.

We acknowledge with thanks receipt of calendars from the following firms: Schumacher & Boye, Cincinnati, O.; Western Gas Engine Company, Los Angeles, Cal.; American Blacksmith Company, Buffalo; American Woodworking Machinery Company, Rochester; Triumph Electric Company, Cincinnati; Kutztown Foundry and Machine Company, Philadelphia.

J. J. McCabe, No. 30 Church street, New York City, the well-known machinery dealer and manufacturer of "2-in-1" double-spindle lathes, requests us to again publish warning against an impostor now traveling through the country under the name of "Eddie Ward," and misrepresenting himself as traveling salesman in McCabe's employ. It was only this summer an account was published in this paper of how Ward buncoed a shop in Oregon City, Ore., by collecting a deposit on a machine represented by Ward as part of McCabe's stock. While nothing has been heard of Ward since that time, he has now turned up according to

A New 240 x 42-Inch Spur Gear Planer

Direct Driven, Simple, Adaptable and Effective Design, Comprising a Wheelpit, Cutter-operating Shaper Mechanism and Indexing Mechanism

SPECIAL CORRESPONDENCE

Recently a special gear planer has been designed, built and put into operation at the plant of the Fawcus Machine Company, Pittsburg, Penn. It was designed for cutting large spur gears and has a capacity up to 240 inches in diameter and 42 inches face. It is seen in the three accompanying half-tone engravings, Figs. 1, 2 and 3, which show the machine from two positions in front and from one position in the rear. The simplicity of the design is immediately apparent from a study of these illustrations.

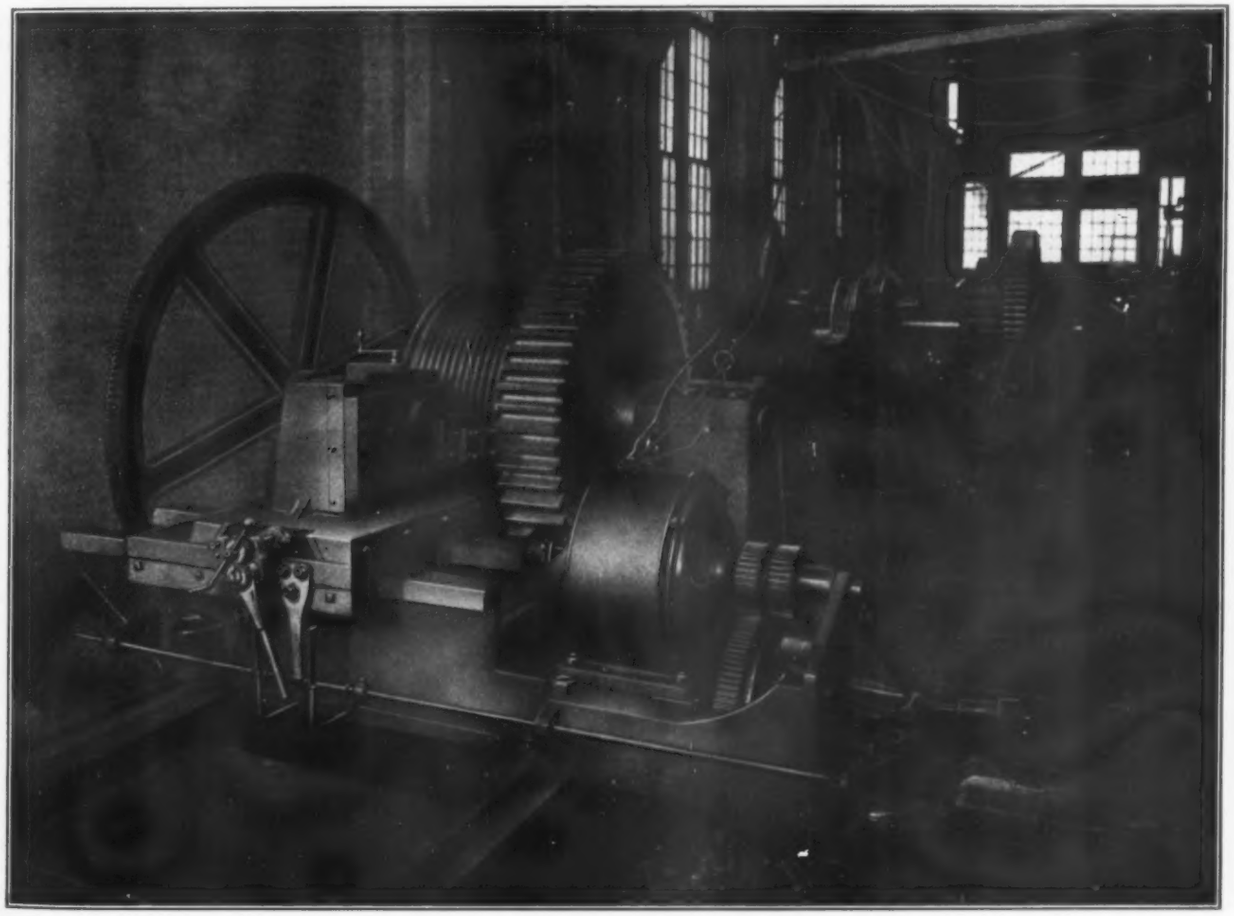


FIG. 1. FRONT AND DRIVING END OF FAWCUS GEAR PLANER

It uses a single-pointed cutting tool and generates the profiles of the teeth from formers. In this respect it parallels the principles of well-known gear planing machines, and is, of course, capable of cutting teeth of any size and shape.

General Features

The general features of the machine comprise a wheel-pit cast of concrete and carrying on its upper edges two rails or ways. Upon these ways are mounted two heavy pillow blocks carrying the work and indexing-wheel shaft. This shaft is 8¼ inches in diameter and its bearings are provided with full caps, thus insuring a maximum of rigidity. In front of these two pillow blocks is the cross rail or main slide which carries the driving mechanism, cutting tool and feeding mechanism complete. On the left-hand side of the machine, as one faces the front, is the indexing operating mechanism. This is not well shown in any of the half-tone illustrations, but it is in the left-hand upper corner of Fig. 3.

A consideration of these features makes it apparent that they are adaptable to a machine capable of cutting gears of any size. The machine described is by no means a limiting size.

While we have characterized the machine as a gear planer it might better have been referred to as a gear shaper, for the action of the slide that carries the cutting tool is essentially the same as the action of a shaper ram.

Driving Mechanism and Reverse

Referring now to Figs. 1 and 2, it will be seen that the machine is self-contained as far as the application of power is concerned. On the right-hand end of the slide is mounted a 10-horsepower, continuous-current, variable-speed motor which furnishes all of the power required by the machine, with the exception of a small amount used in indexing; this is furnished by a small auxiliary motor not shown. This second smaller motor is not essential to the operation of the machine, however, for provision is made for indexing by

hand. Referring to Fig. 1 the motor will be seen with an extended shaft and outboard bearing. Upon this shaft are mounted two spur pinions of the same size; the inner is of rawhide and the outer of steel. The inner pinion meshes with a steel gear which runs freely upon the main driving shaft of the slide. This shaft does not show in any of the illustrations but passes horizontally through the base of the slide, and at a short distance above the ways. The steel pinion on the motor shaft meshes with an intermediate rawhide pinion that can be best seen in Fig. 3. This in turn meshes with a steel gear on the driving shaft. This gear is also loose on its shaft and is smaller in diameter than its mate to which we have referred. The larger of these gears is for the drive or cutting stroke while the other is for the speeded reverse. The speed ratio is approximately 2 to 3.

Between these two gears is located a friction clutch. The section of the driving shaft upon which this clutch bears is hollow to the nearer or right-hand end; in its bore is located a short rod which is keyed to the clutch through a spline or slot cut through the wall of the shaft, and of such a length that the clutch can slide backward and forward, into and out of positions of contact with the two steel gears on the driving shaft. Its motion is, of course, controlled by the short rod or shaft that we have mentioned as located in the bore of the driving shaft at the right-hand end. This is the reversing mechanism of the machine.

The driving shaft is carried backward under the tool saddle, passing through two bearings which are spaced near together. Between these bearings is a worm; this worm drives a cross shaft, one end of which is indicated by the letter *K*, in Fig. 2. On this shaft are a worm wheel that meshes with the worm on the main driving shaft, and two spur gears; one on either side. These spur gears in turn mesh with straight racks on the under side of the saddle; these racks are spaced near the edges of the saddle in order to do away with any tendency to cramp or twist when the saddle is in motion.

On the front of the saddle is an arm that projects downward and fits over the long shipping rod, shown best in the lower part of Fig. 2. Upon this rod are adjustable spring-cushioned stops indicated by the letters *D D*. As the saddle moves forward and backward it operates the shipper rod through these stops and the rod in turn operates the friction clutch, that we have described, by means of segmental rocker arms on the extreme right-hand end of the main slide.

Saddle Mechanism

The saddle carries a main horizontal slide, having its motion in a direction parallel to the length of the ways, and also a bracket to hold the former. This bracket is, of course, without motion. This horizontal saddle slide, indicated by the letter *G* of Fig. 2, carries two vertical slides *B* and *C*; the front slide *B* carries the tool block in a horizontal position; this is arranged to swivel to provide an easy means of adjustment. The rear vertical slide *C* carries the former rider pin, indicated by the letter *A*. The slide *B* has a vertical adjustment on the slide *C*, but has no direct connection with the rider pin. It can, however, be locked rigidly to the slide *C* by means of a bolt which can be seen in Fig. 1 near the tool block. The advantage of this adjustment, that is, the slide *B* with reference to slide *C*, is to facilitate the setting of the tool

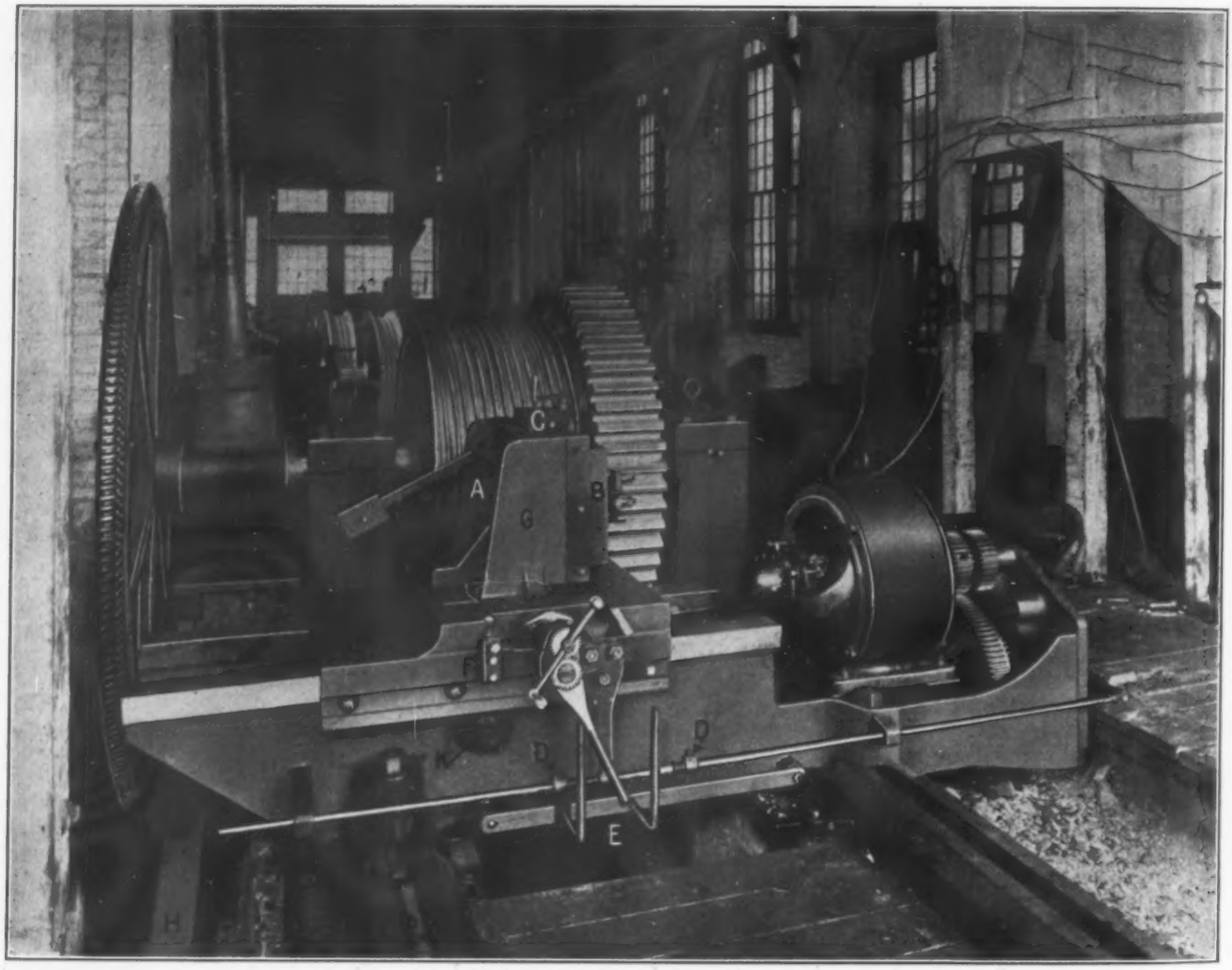


FIG. 2. FRONT OF FAWCUS GEAR PLANER SHOWING FEEDING MECHANISM

for the various cuts. After this setting has once been made the two slides are bolted together rigidly and move in unison; driving their motion from the rider pin and former. The handle used for adjusting the two slides with reference to one another is shown directly above the slide *C*.

Feeding Mechanism for the Tool

The power feed for the cutting tool is obtained by means of the ratchet, shown best in Fig. 2. This swings between two dogs indicated by the letter *E*; its action is obvious. A stop for this feeding motion is the screw *F*. As this stop is positive, the ratchet is provided with a friction so that when the proper depth is reached, as determined by the position of the stop screw, this friction will slip and further feeding cannot take place. A handle is also provided to be used in setting the slide *G* or for hand feed if desired.

Indexing Mechanism

The indexing wheel at the left-hand side of the machine is split and has 240 teeth of 1¼-inch circular pitch. It meshes with a single-threaded worm which is located in a place of safety beneath the wheel and which does not show in any of the illustrations. An adjustment is provided of the worm with reference to the wheel, to be used in taking up possible wear. A set of four change gears is provided. From this mechanism a shaft *I*, Fig. 2, is extended to the front of the machine and carries a single-notched indexing plate. This is operated from a vertical shaft through spiral gears; as we have already mentioned, this indexing can either be done by power from a small motor, or by hand. The arrangement is such that all of the backlash is taken up in one direction, and thus has no influence upon the indexing of the machine.

Although the machine has been in use but a few weeks it is proving to be very effective. On large gears five cuts are ordinarily taken; the first for stocking out, then two roughers, one on each side of each tooth, and two finishing chips. Two formers are used, one for each side of the teeth.

As a matter of interest, the gear which is shown in the illustration in the act of being cut, is part of a drum for a winding engine; it has 59 teeth 3¼-inch circular pitch, 11-inch face, and the tooth form is a 20-degree involute with an addendum equal to the addendum of the standard 14½-degree interchangeable involute system.

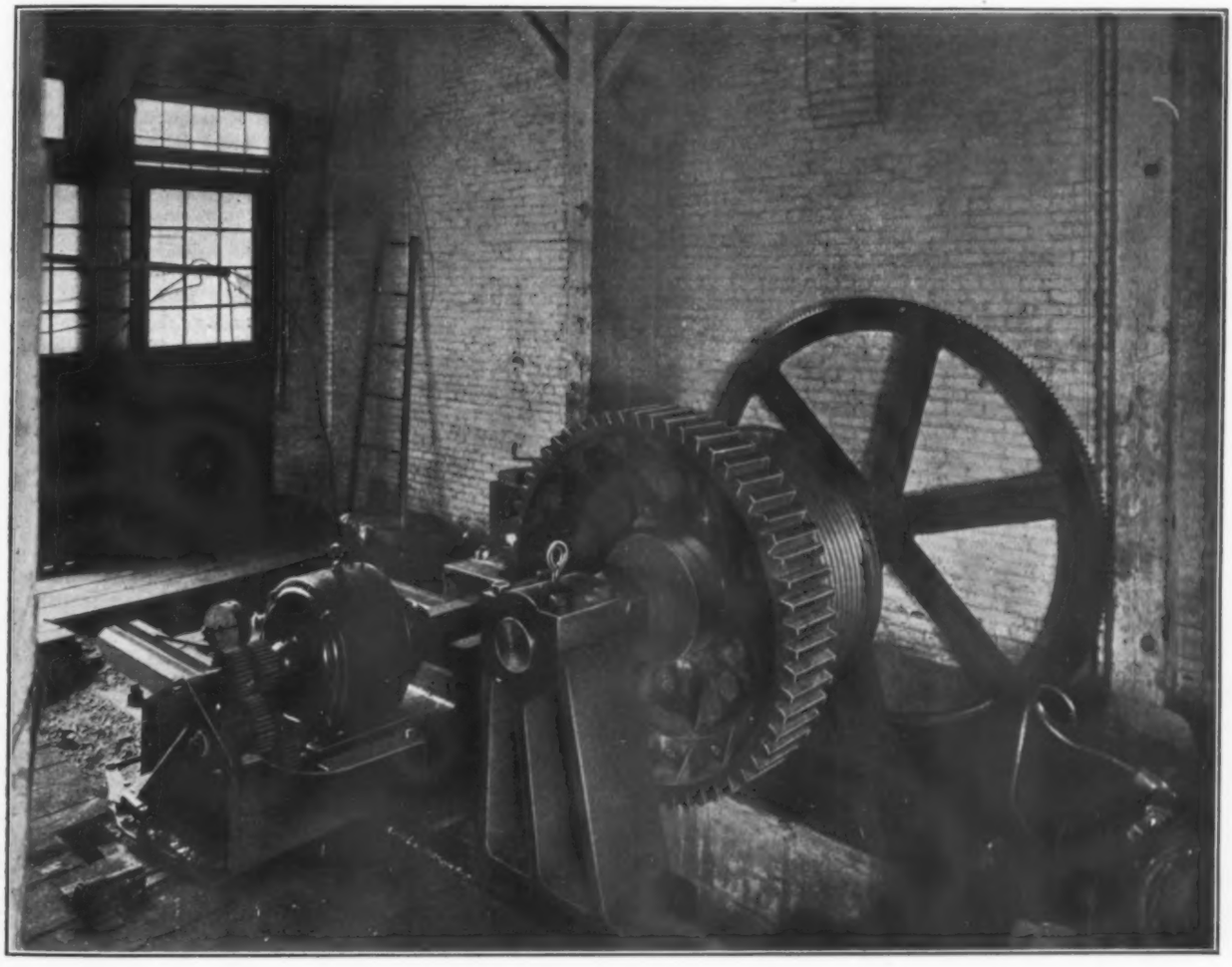


FIG. 3. REAR OF FAWCUS GEAR PLANER SHOWING GEAR PIT

Graphite as a Lubricant for Gas Engine Cylinders

By Walter N. Durant

Becoming interested in the above subject and having access to a new 6-horsepower horizontal engine, using city gas for fuel, I determined to make some experiments. Finding it impossible to mix graphite and oil and feed it through the ordinary lubricator, the experiments were confined to feeding the graphite dry through the air intake and continuing the use of cylinder oil through the lubricator. At first about an ounce of graphite was fed through the air intake at short intervals, but after each charge the engine would show increased internal friction; however, it would quickly pick up and then appear to run smoother than before. The quantity of graphite was reduced and it was soon found that the best results were obtained when the engine was not

given more graphite than could be consumed in the cylinder, or about 1/12 to ⅛ ounce per horsepower in a 10-hour run. This amount should not be fed all at once, but distributed as evenly as possible throughout the 10 hours.

The experimenting extended over a period of four months, and during that time the engine was given some severe tests. The spark plug was always in good condition and never missed fire became carbonized or short-circuited. The cylinder and valves were frequently examined; the latter were in fine condition and the cylinder did not show a sign of a scratch, but had that smooth, dull appearance which indicates the absence of friction. Unfortunately it was impossible to determine the amount of fuel saved by the use of graphite as the engine was under a constantly varying load.

Desiring to know what others thought of graphite as a cylinder lubricant, I wrote to 45 prominent gas engine manufacturers asking if they recommended its use in their engine cylinders. The majority of replies stated that the writers had none, or very little personal experience, and declined to express an opinion. The answers containing advice were interesting, but rather conflicting, and no information could be gained from a reply like this:

"It is not customary with us to use graphite in the engine cylinders, although we sometimes use a little where the condition is, in our opinion, such as to make its use desirable."

The following is a little more explicit:

"The great trouble with graphite is to apply it properly, so as not to plug the rings and make them stick. If properly applied, however, graphite is indeed an ideal method of lubrication, but, of course, must be used with oil."

A prominent firm making high-grade auto engines writes:

"We would recommend the use of graphite once in a while in your crank case. Same will do no harm. It has a tendency to close the pores of your cylinder and polish same up so as to increase the compression. It is a good thing."

A large marine gasolene motor manufacturer also says:

"Smear the cylinder walls with it. Once a month is often enough to do this. Of course, in addition the regular amount of oil should be fed through the multiple oiler. Graphite will help to retain good compression."

Another well known gas-engine company writes:

"We use more or less graphite in connection with lubrication, and where properly used much better results can be secured than with lubricating oil alone. If the cylinder has been allowed to cut slightly because of lack of oil there is nothing that will put it in shape so quickly as the use of graphite. Where good flake graphite can be mixed with oil and fed to the cylinder good lubrication is certain."

The manager of a large company making gasolene marine engines writes:

"We consider graphite the best lubricant in the world for gas-engine cylinders. The trouble in using it is in getting it into the cylinder. So far no satisfactory means have been devised. We think so much of the lubricating qualities of graphite in cylinders that we make it a rule to thoroughly coat the inside of every cylinder with it before sending our engines out from the factory. If one of our customers should ask us the question we should tell him to use it by all means if he could get it into the cylinder."

A New York City builder says:

"We think graphite lubrication is very good providing you have the proper means for furnishing the graphite in the required and constant quantity so that it will reach the parts to be lubricated."

The objections to its use were: "Forms lumpy spots on valve seats. Has a tendency to carbonize spark plugs. The expense in using it would overcome the advantages."

Nearly all of the firms who did not recommend the use of graphite, pointed out the impossibility of mixing graphite and oil and the certainty of clogging the lubricator if fed in that way. Aside from this, the only objection I can see is in using too much at one time in small cylinders. Judging from the correspondence and my experiments, I believe a little graphite frequently applied will keep the cylinders and running parts in very much better condition than when oil only is used.

Rapid Punching Records

At the structural shops of the receivers of Milliken Bros., Inc., on Staten Island, New York City, recently, 143 tons of plates were punched in one day (8 hours, 47 minutes to be exact) on one machine tool. The plates were 13-inch flange plates for girders, ⅝ inch and 11/16 inch thick and averaging about 32 feet in length. The average number of 15/16-inch holes was about 96 to each plate, staggered except at the ends.

There were three sizes of plates and varieties of spacing; 52 of one kind, 168 of the second and 96 of the third. The total length of plate handled was 10,036 feet; weight 285,850 pounds, and total number of holes 30,384. This work was done on a multiple punch, four plates being passed through at a time.

A few days previous to this, one man punched 12,740 9/16-inch holes, one at a time, in ten hours. This was on light transmission line tower angles, on a light single-stroke, quick-acting punch.

These performances are believed to be records in the line of rapid punching in the bridge shop.

A Hobbing Cutter for Finishing Wheels

By P. A. Thompson

No engineers are more exacting in their demands for silent-running gear wheels than the manufacturers of motor cars. It is, therefore, of great interest to see what they consider the most perfect means today of cutting gear wheels. Most of the leading firms rough out their wheels on gear-hobbing machines. A hobbed wheel is more accurate in pitch than a wheel cut with a single milling cutter, for owing to the fact that the teeth are generated in circles the blank is heated equally all around instead of becoming heated locally, as is the case when the teeth are cut one at a time.

Moreover, as the single milling cutter loses its sharp edge the centers of the blank and cutter are forced farther and farther apart, so that a line scribed round the bottoms of the teeth is not a perfect circle, but a scroll. The hob has many more cutting points than the milling cutter and, therefore, the effects of wear are not so apparent. In any case all the teeth will be exactly the same as we go round the wheel, although the whole depth of the teeth may be very slightly greater on the side on which the hob entered than on the side on which it left the blank.

But, although in a hobbed wheel we get practically perfect spacing of the teeth, the shape of each individual tooth is not quite perfect. This is due to the fact that while the cutting is intermittent the blank rotates continuously. Hence between the time that one blade has finished its cut and the next blade takes on, a small piece of metal that should have been removed escapes. The effect of this is that if a hobbed tooth is carefully examined its outline will be seen to consist of a series of flats. The more blades there are in the hob the smaller the flats become, and if we were able to make a hob with an infinite number of blades it would generate a perfect involute. The number of blades in the hob is, however, limited by the diameter of the hob, and this cannot be increased indefinitely for many reasons. In the first place, the larger the hob the slower it must be run to give the same cutting speed, and, consequently, as we increase the diameter of our hobs we decrease the output of our machine.

Then it is an exceedingly difficult and costly matter to make and harden a large hob of solid high-speed steel. Even with the hobs of moderate diameters that are now used there is always the danger that they will go out of truth in the hardening, and only by great experience, aided by a certain amount of luck, can an allowance be made for the distortion which inevitably takes place.

Motor-car Practice

The motor-car manufacturer, therefore, uses a hob of moderate diameter to rough out his wheels; thus he gets the teeth more perfectly spaced than is possible with any other method, while he also takes advantage of the greater speed of the hobbing process over cutting the teeth one at a time. To finish the teeth, however, a light cut is taken through each tooth space with a formed milling cutter, specially manufactured to suit the particular number of teeth in the wheel. This combination of two different methods can scarcely be considered satisfactory.

A Special Finishing Hob

Figs. 1, 2 and 3 show a hob specially designed for finishing motor-car gear wheels, with which excellent results have been obtained. The hob has been patented by Mr. Humpage, and is manufactured by Messrs. Humpage, Thompson & Hardy, of Bristol, England.

As will be seen from the figures the hob has 30 blades of carbon steel inserted in grooves in a mild-steel body. The grooves are cut straight through the body without any spiral twist. In transverse section the center lines of the grooves are not radial, but form tangents to a small circle concentric with the body of the hob. The cutting blades have teeth milled out, as in solid hobs. They are hardened and ground to fit the sides of the grooves, and over the ends so that they fit exactly between two nuts screwed onto a shoulder at each end of the hob body. The blades are then inserted in the grooves and held down by keys; the teeth form a thread, as in an ordinary worm. The nuts prevent any endwise movement of the blades. The teeth are then ground up all over the tops, bottoms and sides in an ordinary grinding machine, to insure the correct shape of the thread which may have been distorted in the process of hardening. The tops of the teeth are now concentric with the body of the hobs, as shown in Fig. 1. The blades are next taken out of the body, turned end for end and replaced in the grooves, as shown in Fig. 2. The first blade is merely reversed in its own groove, but blade No. 2 is now placed in the groove formerly occupied by blade No. 30, which latter blade is placed in the groove formerly occupied by blade No. 2. Similarly blades Nos. 3 and 29 are interchanged, Nos. 4 and 28 are interchanged, and so on all around the hob.

In the new positions of the blades the thread will have the correct thread as before and the tangential setting of the blades will give the correct backing-off or clearance, as shown in Fig. 2.

It will be seen that in a hob built up in this manner no special machine is required to give the backing off to the cutting teeth. The finished shape can be given to the teeth by grinding in an ordinary grinding machine after the blade has been hardened, and if the shape of the cutting blade has become slightly distorted in the process of hardening, this will be corrected by the subsequent grinding. Hence in these hobs extreme accuracy is insured. Moreover, owing to the large number of blades in the hobs the flats which are observable in teeth cut with an ordinary hob can no longer be detected, even with a magnifying glass. In an ordinary hob, as is well known, one tooth must be set on the center line of the machine. If this precaution is neglected the hobs will cut drunken teeth. In the finishing hob this is unnecessary for the number of teeth is so large as to approximate to a continuous thread and however the hob is set, one tooth is certain to be practically on the center line.

Again, an ordinary hob must be tilted to the angle of spiral of the thread and the flutes dividing the teeth are also spirally cut. Thus a section of the hob teeth in mesh with the blank that is being cut never forms a true rack with sides equally inclined. In effect an ordinary hob always leaves a little too much on the points of the teeth that it cuts. Some makers have attempted to remedy this defect by making the sides of the hob teeth slightly hollow, but this is departing altogether from the basis of the true rack. Moreover, as soon as the straight-sided tooth is abandoned and teeth with curved sides are introduced, we have a source of endless trouble in the manufacture.

The finishing hob has straight blades without any spiral twist and the angle of spiral of the thread is so small, owing to the large diameter that no tilt need be given to the hob. It is true that this will result in the teeth being cut too thin but, the difference is practically imperceptible. If extreme accuracy is desired the hob teeth themselves may be ground a shade under the standard thickness to compensate for the absence of tilting. Thus each blade of the hob is a true rack which comes down squarely on the blank and only in this way is it possible to generate a true involute tooth.

As regards cost the finishing hob is, of course, more expensive than an ordinary hob of the same pitch, but owing to the fact that it has three times as many blades its life is longer in the same proportion. Also, if one tooth gets broken the hob is not ruined for the blade can be replaced at comparatively small cost.

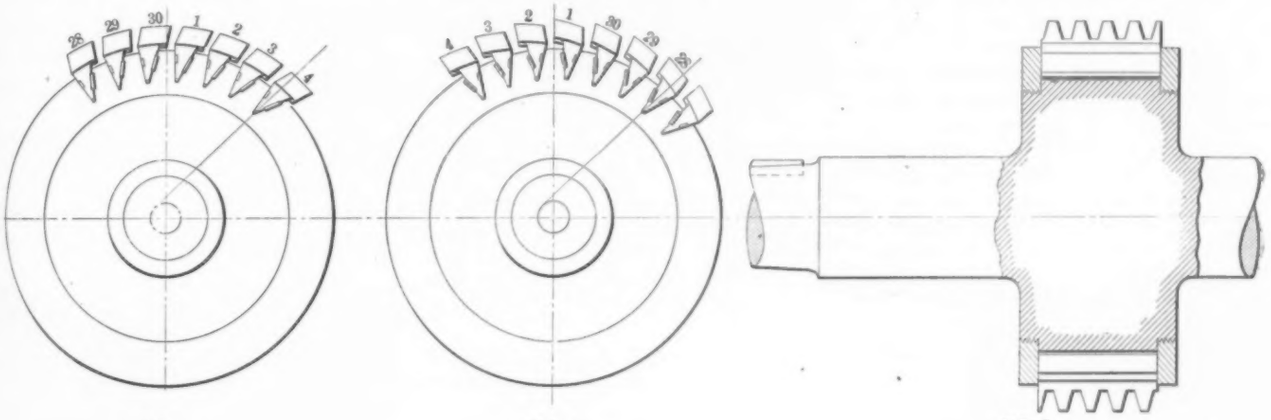


FIG. 1 FIG. 2 FIG. 3

A FINISHING HOB WITH INSERTED TEETH

When we come to hobs of large pitch, which are at present very costly when made out of solid pieces of high-speed steel, a hob with an equal number of inserted blades can be made for a smaller price. In addition to the advantages of the inserted-blade hobs which we have already pointed out, it must be remembered that to the manufacturer there is a clear gain in the expensive backing-off machines which are now used to relieve the teeth.

To those who have never seen the cutting of steel and iron by the oxy-acetylene process, the results and rapidity of the operation are truly surprising. After the metal is brought to a red heat by the ordinary welding flame, this flame is continued and a jet of pure oxygen is turned on which unites with the carbon of the metal and disintegrates it very rapidly. The cut is narrow and smooth and can be made in any shape, the process being particularly useful in cutting irregular forms and making many kinds of dies.

Autogeneous Welding with Oxy-Acetylene*

The Torches Used. Methods of Generating the Oxygen and Acetylene. Testing Oxygen. Rules for Welding Steel, Cast Iron, Brass, Etc.

BY HENRY CAVE

It is not generally known that three distinct types of torches have been invented for oxy-acetylene welding. These are termed respectively low, medium and high pressure, taking their name from the relative pressure under which the acetylene is used.

The high-pressure torch was never introduced into this country, owing to certain disadvantages that caused the medium-pressure torch to be brought out. What is really the medium-pressure torch is, therefore, known in this country as the high-pressure and will be spoken of as such in this paper.

Low-pressure Torch

The low-pressure torch was invented by Edmond Fouché, and its principle is based on that of the injector, the acetylene being drawn by suction produced by the flow of oxygen, which is under pressure. The acetylene is brought to the torch under a pressure of a few ounces per square inch only. The flow of oxygen is regulated by the area of a nozzle and by its pressure so that the correct proportion of acetylene is sucked in. The mixture then passes out at the burner or tip of the torch. The size of the orifice in this tip is of great importance, as it controls the resistance

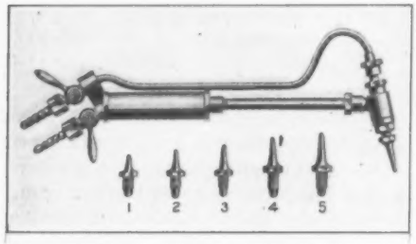


FIG. 1. SMALL TORCH AND TIPS

in the mixing chamber to the flow of oxygen, and, therefore, controls the proportion of the two gases.

As is well known the amount of fluid sucked by an injector is proportional to the square of the velocity of the propelling fluid. It is, therefore, essential that the flow of oxygen should not vary or the proportion of acetylene would not be constant. For the low-pressure torch this proportion is 1.7 oxygen to 1.0 of acetylene by volume, at atmospheric pressure, and any variation in either direction will produce either an oxidizing or carbonizing flame. The flame should, therefore, be carefully watched, as the orifice in the tip may be expanded by the heat being deflected onto the torch, or it may be contracted by particles of metal adhering to the tip, thus changing the mixture. Owing to the fine adjustment of the injector parts, these torches are often made without any means of varying the size of the

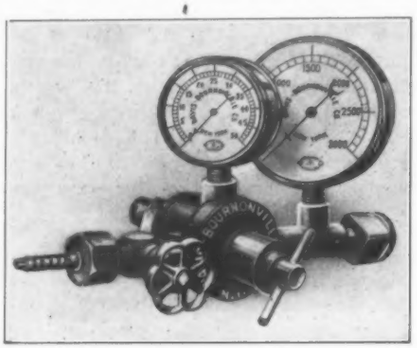


FIG. 2. OXYGEN REDUCING VALVE

flame, it being necessary to disconnect the torch from the hose and substitute another one, when it is desired to do this. A number of torches are required if it is necessary to weld on all classes of work.

Owing to the low pressure, the speed of the issuing mixture is very little above the speed of the propagation of the flame, and back-fires frequently occur; the gas has then to be turned off, lighted again and the mixture readjusted. The ordinary acetylene lighting generator supplies gas at a pressure suitable for use with this torch. In France the use of this torch has been largely superseded by the high- (medium) pressure torch.

High-pressure Torch

This torch was brought out in France by Boas-Rodrigues & Company, of Paris, the manufacturers of the well known B. R. C. automobile lamps, and was introduced in this country by the Davis-Bournonville Company, of New York. Both the acetylene and oxygen are under an appreciable pressure which results in a constant mixture under all conditions, the proportion being 1 of acetylene to 1.3 of oxygen. The mixture is regulated by holes at the inner end of the detachable tip, see Fig. 1, and is not affected by any variation at the outer orifice. The pressure of each gas is kept constant as required by adjustable reducing valves, shown in Figs. 2 and 3. The torch can, therefore, be extinguished and lighted again any number of times after once adjusting the mixture, without any attention having to be given to the condition of the flame. The tips are detachable, and five of varying capacity are supplied with each torch which allows a considerable range of work to be carried out without changing torches.

Owing to the high pressure, there is very little trouble from flashing back. The speed of the gases being well above that of the propagation of the flame, flashbacks only result from touching the metal with the torch, or from the heating of the torch, by the flame being deflected back onto it. This torch receives its acetylene from a special pressure generator, such as is shown by Fig. 4, which produces gas up to 15 pounds pressure, and whose action is entirely automatic.

Dissolved acetylene can be used with this torch, a special high-pressure reducing valve being required. This equipment is very useful where the work cannot be brought to the plant, owing to its portability, but owing to the increased cost of acetylene under these conditions

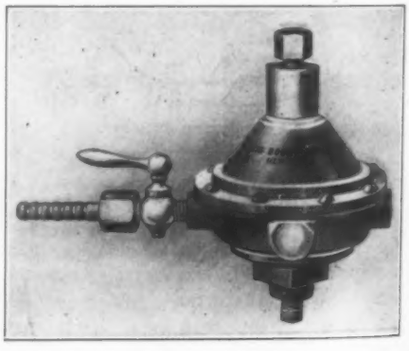


FIG. 3. ACETYLENE REDUCING VALVE

it is not so economical as the generator for regular use.

Acetylene

One of the principal rules that apply to the generation of acetylene is that the excessive heat during generation must be guarded against. This is owing to the fact that excessive heat tends to change the chemical character of the gas due to its conversion, to some extent, into oily matters, which result in a reduction of the amount of gas produced, and also causes trouble by clogging up pipes and burners.

The way to avoid this is to generate the gas by what is termed carbide feed; that is, by dropping the lumps of carbide into

*Condensed report of paper read before the Automobile Engineers of America, at their New York meeting.

a large volume of water, a gallon of water to every pound of carbide being recommended, which does away with any possibility of heating, and in addition, the gas bubbles up through the lime water which thoroughly washes it. The lime, of course,

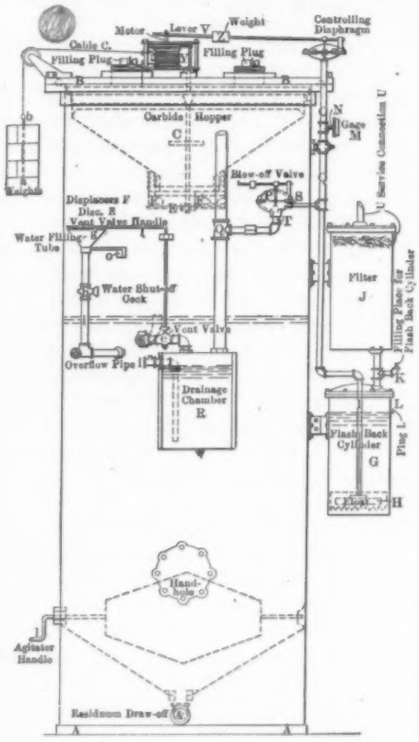


FIG. 4. DAVIS PRESSURE GENERATOR

being the residue from the carbide, and the solution produced is the best possible cleanser for acetylene.

Water-feed generators should be avoided as it is impossible to obtain cool generation by this method and the washing feature is lost. The lumps of calcium carbide should not be too small, or it will rest on the surface of the water, and the above advantages will be lost; also the larger surface results in increased air slacking taking place, which reduces the amount of gas produced per pound. Too large carbide, however, gives irregular generation with considerable variation of pressure and allows the interior of the lumps to heat up. What is called nut (1¼x⅜ inch) is most suitable when taking everything into consideration. This gives 4½ cubic feet of gas per pound of carbide. All measurements of gas, whether acetylene or oxygen are taken at atmospheric pressure. The details of an automatic generator are shown in Figs. 4 and 5.

Dissolved acetylene can be obtained in cylinders of the following capacities:

Diameter of Cylinder, Inches.	Length, Inches.	Capacity, Cubic Feet.	Weight, Pounds.
7	24	50	50
8	30	80	75
10	30	125	105
12	36	225	120
14	48	400	349
16	48	500	435

All cylinders are charged at 150 lb. pressure.

Oxygen

The source of oxygen supply is a question which requires careful consideration for each individual case separately. It can either be generated at the plant, or can be shipped in steel cylinders from one of the several companies who are generating and compressing it.

The points to be considered are: First, the cost and transportation charges for the compressed gas and of the cylinders. Second, the quantity of gas and, therefore, the number of cylinders that would be required to contain it. Third, the regularity of the consumption, depending on the regularity of the work, and also of its size. Fourth, the cost of generating the oxygen at the plant.

In a recent article that mentioned the cost of materials the price at which the chemicals could be purchased to make oxygen by the chlorate of potash and manganese-dioxide process, which is by far the most suitable for small equipments, was given as 8 cents per pound, and I think this is close to the minimum price and does not include transportation charges. The mixture required is 100 pounds of crystallized chlorate of potash to 13 pounds of the best quality manganese dioxide.

The cost of the chemicals per cubic foot of oxygen at the above rate would be about 2.25 cents. The manufacturing charges would, of course, have to be added to this, and they depend considerably upon the methods used in figuring by those in charge of the cost system. Details of the Davis-Bournonville oxygen generator are shown in Fig. 6.

Test of Oxygen

The purity of the oxygen used has a great deal to do with the strength of the weld produced. It is, therefore, very essential that oxygen with the least impurity should be used. The oxygen that can be obtained at the present time varies from 80 to 99 per cent. pure, the latter purity being obtained by an electrolytic process. The apparatus shown by Fig. 7 is used to test the purity of oxygen, and consists of a burette or gas meter *A* of 100 cubic centimeters capacity, a glass tube *B* running from the top and having a three-way cock *C* at the other end, there being an intervening branch with a stop cock *D* connected to a glass receptacle *E* that is filled with short lengths of glass tubing to prevent bubbles in the contained liquid. The upper end of this receptacle has a clearly distinguished mark *F* located immediately below the stop cock. The bottom end of this glass receptacle is connected by a U-tube to the bottom of a similar vessel *G* to whose upper end is connected a rubber bulb *H*. The two glass receptacles are half filled with a mixture which we will call the absorption liquid, the two solutions not being mixed until they are poured into the glass receptacles as they would absorb oxygen from the air. These mixtures are for the first, 1 ounce pyrogallic acid to 150 cubic centimeters water, and for the second, 48 grams caustic soda (sodium hydrate purif.) to 50 cubic centimeters water.

A rubber hose connects the bottom of the burette with the bottom of the vessel *K* which contains water. Gas contained in the burette is displaced by raising this vessel and allowing the water to flow into the burette.

The test is made as follows: Air is dispelled from above the absorption liquid contained in *E* and *G* by pressing the bulb *B* with the stop cock *D* open, and closing it when the liquid reaches the mark *F*. Air is then expelled from the burette and glass tube by raising the bottle of water until the water flows out at one opening of the three-way cock *C*. The other end of the three-way cock is then opened to the source of oxygen supply. The water is thus lowered in the burette until a given quantity of oxygen is drawn in, as shown by the relation of the surface of the water to the graduations, allowance being made for the volume in the tube. The water is then raised, the stop cock *D* opened and the oxygen forced into the receptacle containing the absorption liquid, care being taken to close the cock before the water enters. After a time the stop cock is opened and the oxygen allowed to

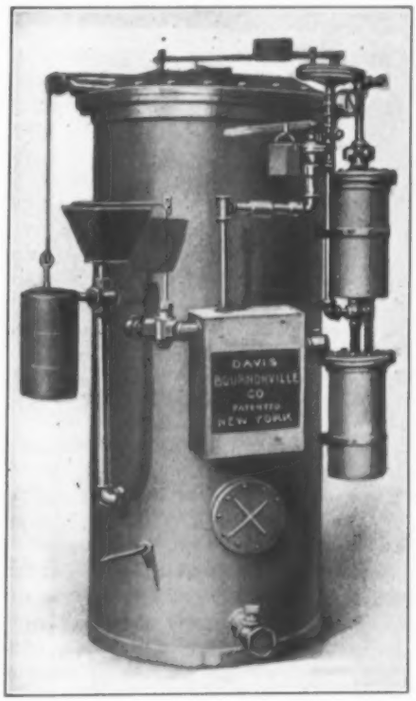


FIG. 5. DAVIS PRESSURE GENERATOR

pass back into the burette, the stop cock being closed when the absorption liquid reaches the mark *F*. The water bottle is held so that the surfaces of the water are level, so as not to apply any pressure to the oxygen. The relation of the surface

of the water to the graduations is then noted, the difference between this reading and the one first taken being the amount of oxygen absorbed. This is repeated until the readings come alike, which shows that all the oxygen has been absorbed by the liquid. The gas remaining in the burette is the impurity, and the percentage can be determined readily. The absorption liquid is good for 100 or more tests.

Chemical Generation of Oxygen

In the low-pressure generation of oxygen with compressor and external heat as carried out with the Davis-Bournonville apparatus, shown in Fig. 6, the pressed-steel retorts *A* are filled with a mixture of chlorate of potash and manganese dioxide, and the oxygen is driven off by heat, applied externally by a gas burner *B*. The oxygen bubbles up through the three washers *C C C* which contain a solution of caustic soda. It then passes into the copper gas holder *D* from which it is pumped by the two-stage compressor *E* into cylinders at a pressure of 300 pounds per square inch. The object in compressing it as high as this is to obtain sufficient pressure for cutting thick steel with an oxygen jet, and also to reduce the dimensions of the cylinders to a practical size.

In high-pressure generation with external heat without a compressor, the oxygen is generated from the same chemicals and the pressure is produced by the generation of the gas. This somewhat simplifies the plant but is attended with certain disadvantages. A large amount of oxygen is lost due to it being under pressure when the retorts are open for the refilling, and also from the washers, if they are of adequate size. Owing to the retorts having to stand considerable pressure they are much heavier and require considerably more heat or longer time to generate the gas and there is much more chance for leakage. The covers also have to be much more securely fastened, and therefore take longer to adjust. Possibly the greatest disadvantage is the fact that, owing to the bubbles of oxygen passing through the washer under considerable pressure, they are very small, and do not offer much surface to the liquid. The washer would, therefore, have to be many times the capacity to give equal purity to the oxygen that is obtained by the low-pressure process.

The maximum pressure at which it would be practical to generate oxygen in this manner would not be sufficient to cut thick steel, and the cylinders would either be of small capacity or be of an unwieldly size.

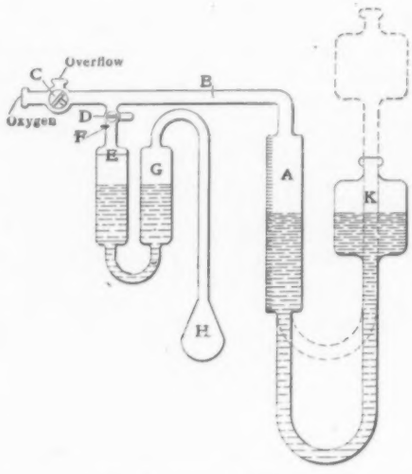


FIG. 7. OXYGEN TESTER

High-pressure generation of oxygen is also accomplished by internal heat, without a compressor. This is done by using the chemicals mentioned above and adding to this a certain proportion of carbon, lamp black being used. The carbon is ignited by means of an ignition powder and the retort is then closed, the combustion continuing due to the supply of oxygen generated.

It is very essential that carbon in any form should be entirely eliminated in the manufacture, storage, and use of oxygen. Oil should not be used on compressor, valves, gages or any other part, even spindle- and rod-packing material should be free from hydrocarbons. The manganese dioxide used in generating the gas should be free from carbon, therefore only the best should be used.

Strength of Oxy-acetylene Welds

A good deal of comment has been heard as to the small amount of knowledge we have regarding the strength of oxy-acetylene welds under the vibration test. One might also suggest that though electric welding is extensively used on certain parts of machinery, some of which are of vital importance, very little is known of the strength under these tests; but apart from that, not one-tenth part of the welds that would be carried out with this process would come under these considerations at all; for instance, cracks in new frame members of automobiles are invariably lengthways of the metal and do not materially affect the strength of the part, and these can be welded cheaper than they can be returned to the maker. How often squares on the ends of shafts will come a few thousandths of an inch small, and how much better it is to weld metal on and remill them than to electroplate them as I have known to be done.

If an automobile frame cracks or breaks in use it is necessarily a repair job, and there is no need to try and entirely hide the defect, and, therefore, there is no objection to building up metal on the inside to any amount that would entirely eliminate any possibility of future breakage at that point. Useless holes in frames due to change in design or errors can be welded up solid and are far better than the usual plug which does not add to the strength and eventually shows through the paint.

Inlet and exhaust manifolds and water pipes can be far better welded up out of tubing than either cast or brazed up, and there is a very large sphere of usefulness for this process in places where extreme strength is of no importance, though this can be obtained in most cases.

As an instance of the use of autogenous

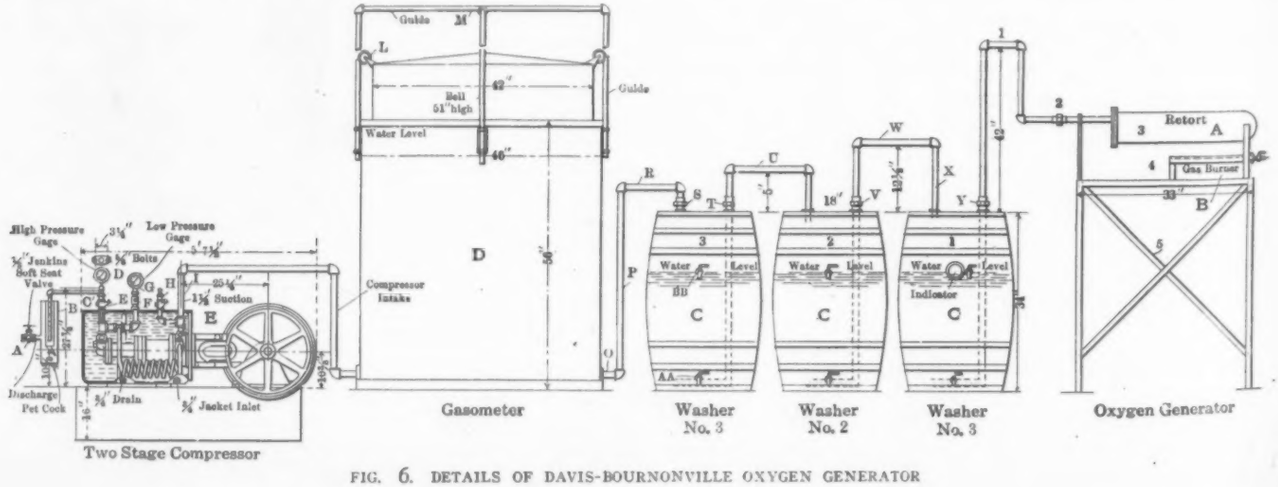


FIG. 6. DETAILS OF DAVIS-BOURNONVILLE OXYGEN GENERATOR

welding in France most of the members of this society will remember the frame used by the Darracq Company several years ago. The whole frame, apparently, was pressed out of one piece. The engine and the transmission cases were supported by extensions of the bottom flange of the frame, but this supporting pan was solid at some parts with the upper flange and must have been welded. This condition was a veritable Chinese puzzle to the majority of people in this country at that time, as the possibilities of oxy-acetylene welding were not then generally known.

Investigations have proved that it is possible to autogenously weld without materially changing the composition, and also that there is no more carbonization due to the use of acetylene than there is with the hydrogen flame.

Welding Steel

Steel does not become so fluid as the majority of metals, and can therefore be worked in any position. It is possible to weld on the under side, particularly where the high-pressure torch is used, as the high pressure spreads the metal, thus making it possible to weld an automobile frame in place and even add metal to the under side of the upper flange, or to the lower side of the bottom flange as well as to the vertical web.

When adding metal, care should be taken not to let the full force of the flame play on the rod, unless it is in contact with the larger body of metal being welded, which will absorb the surplus heat and prevent it being burned.

As in blacksmiths' welding, the amount of carbon has a good deal to do with the strength of the resulting weld. High-carbon steels do not always prove satisfactory, but high-speed steel can be welded to machine steel without any trouble. This feature should prove interesting to superintendents, as considerable reduction in the amount of high-speed steel required should result by its use.

Broken crank shafts have occasionally been welded, though I do not recommend this unless it is in the web where a large amount of metal can be added, or at the end of a bearing where it can be left large and the bearing correspondingly shortened. This, however, is advisable only in cases where it is difficult to get a replacement.

There is an enormous benefit to be derived from the use of this process to eliminate defects which seem bound to appear in steel castings. The success with which steel castings can be welded depends largely on the nature of the metal and this would, of course, determine the extent to which the welding process could be used.

Commercial soft-steel wire is used as a filler in most cases, but sometimes it is desirable to use pieces from a similar casting and these can readily be cut into strips by the oxygen cutting torch. It is advisable, where possible, to test sample welds where the best combination is not known.

Welding Cast Iron

The welding of cast iron is really the most satisfactory of all metals, as the metal becomes sufficiently fluid to leave a smooth surface. In a molten state the metal flows very much like mercury, that is, it hangs together in balls. These balls have to be broken up by what is termed scaling powder which is used in much the same manner as a flux in brazing. Salt can be used for this purpose, though it is liable to harden the metal. The Davis-Bournonville Company has a powder on the market which is not attended with this disadvantage, the composition of which is somewhat of a trade secret, though the price at which it sells is so low as to make it not worth while trying to imitate it.

Considerable care has to be exercised as to the nature of the filling stick used, as iron containing scrap will often cause trouble by hardening. It is, however, no trouble to obtain soft welds when care is taken in selecting this material. Care should also be taken not to overheat the metal and also to allow it to cool off slowly.

Intricate castings should be preheated all over to several hundred degrees, though not enough to cause serious warping, to reduce the possibility of shrinkage cracks, which might otherwise take place due to the extreme difference in temperature at different parts of the casting. Foreign automobile cylinder castings are particularly liable to this, possibly owing to the large percentage of sulphur which produces hot shortness.

Cast iron has the peculiarity of flowing to the part having the highest temperature; it is, therefore necessary, when wishing to draw metal from one part to another,

FIG. 9. WELDING ALUMINUM

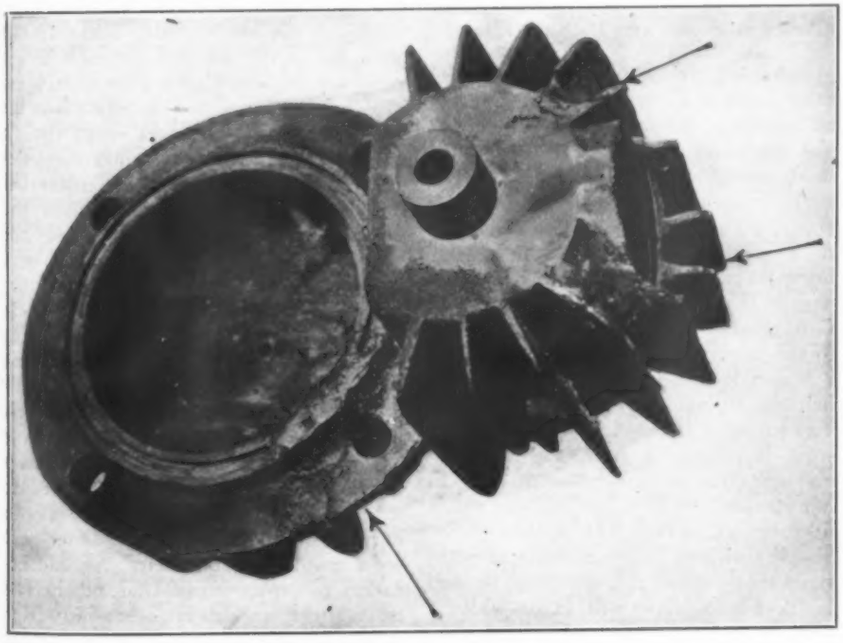


FIG. 8. WELDING CAST IRON

to play the torch on the latter place, but of course keeping the other one molten.

The operator is aware of the blow holes he leaves in the weld, as the metal will not flow over these without special effort on his part, the hole showing as a depression in the surface which must be blown open with the flame so as to close from the bottom, or as is often the case when it is due to sand or slag, it must be dug out with an iron rod to be eliminated. The special effort required to close over this depression consists of playing the torch in a circle around the depression and then suddenly removing it. The momentum of the metal causes it to unite over the cavity. The desirability of doing this is, of course, determined by the requirements of the piece being welded.

A good illustration of what can be accomplished in cast iron with this process is seen in Fig. 8, which shows a 12-horsepower racing motorcycle combustion chamber, the welding on which was carried out at the plant of the Autogenous Welding Equipment Company, Springfield, Mass.

The broken flange was welded up, and metal added around the exhaust boss, which had been opened up for racing so that there was not sufficient metal left to support the exhaust pipe when it was required to attach one.

Welding Aluminum

Possibly the most radical development which this process has produced is the satisfactory welding of aluminum. This has long defied all attempts to unite it in a manner that would withstand a strain anything like the metal itself. It is due to the reducing nature of the flame, which is not sufficient to cause the metal to flow together. The actual uniting is produced by puddling the molten metal with a steel rod which effectually breaks up any coating of oxide. In the same manner bosses and other additions can be added to castings, they being shaped up in much the same manner as one might do with molding sand. The molten metal works in much the same manner as this sand.

Great care has to be taken in handling this metal owing to it having very little strength when heated a few hundred degrees, and this difficulty is increased by its high heat conductivity which allows very little difference in temperature between the place being welded and the surrounding metal. This is, however, taken care of by supporting the metal on the other side with graphite blocks.

Notwithstanding these difficulties very successful work is being carried out in this metal. Large castings that look more fit for the scrap heap are made serviceable again as can be seen by crank cases shown in Fig. 9. On these there is a total of about seven feet of welding. In one case the bearing was broken so that it was not worth while to repair it, and a casting was obtained from the broken part which was welded on.

Owing to the fine adjustment of the gases obtained in the high-pressure torch the temperature of the flame can be somewhat reduced, which facilitates the welding of aluminum.

When casting any metal which is not ductile, there is more or less trouble with shrinkage cracks, and, of course, this is also the case with welding, and though shrinkage cracks can be welded up, in some cases they are produced, as can be realized when it is considered that very often the metal is already taxed to the limit by the internal strains, and the extra strain, produced by heat, or else the weakening of the metal by its application proves to be the last straw. This can be well understood by those who have had experience in soldering aluminum, as the small heat required for the purpose is sometimes sufficient to produce a crack.

This is obviated to a great extent by heating the whole casting uniformly, thus reducing the difference of temperature between the part being welded and the body of the metal. However, the great majority of breakages consist of lugs and arms broken off entirely and there is seldom trouble of the above nature in their repair.

Welding Brass and Malleable Iron

Brass is more difficult to work than most metals and requires more experience on account of the zinc readily burning out and depositing a yellow powder on the weld, and also leaving blow holes. It is advisable to use borax to prevent this deposit. It is necessary to get the metal to a good red heat and then quickly bring the welding flame down on it, and as quickly removing it as each drop flows. Care should be taken not to breathe much of the fumes from the zinc.

Malleable iron is a very unsatisfactory material to weld owing to its variation between what is practically cast iron and what is practically steel, and on thick castings often a combination of both. In most cases cast iron can be used as a filler, but, of course, this is not always advisable owing to its unsuitability to withstand shock. Steel can, of course, be used but does not work so well, except with the kind of malleable iron that is practically steel.

The automobile manufacturer would, however, mainly use the torch on this material to fill blow holes, weld up shrinkage cracks and to add metal to replace errors in workmanship, and in most cases cast iron would be satisfactory for these.

Combinations of Metals

With this process it is possible to unite different metals, those having the nearest fusion temperatures, of course, being most practical. So far, there is very little use for such combinations. The most useful combination, however, is copper and steel; these metals mix in such a manner that it is impossible to say where one commences and the other ends. This is of great advantage for electric conductors, as there is no possibility of oxidation taking place between them and reducing their conductivity.

This has been taken advantage of by the Davis-Bournonville Company in its patent electric rail bond, and ought to prove of use in electric vehicles.

Cast iron and steel can be satisfactorily united, and I believe there is a big future in this for internal-combustion engine exhaust valves, as the desirability of having cast-iron exhaust valve heads has been generally acknowledged, but its adoption has been prevented by the difficulty of satisfactorily attaching the steel stem.

Repairing Cracked Seamless Cast-iron Steam Jackets

By Wm. H. Dopp

When my father, the late H. Wm. Dopp, first began the manufacture of his seamless cast-iron steam-jacketed kettles he was much troubled by shrinkage cracks in the outer shell. These cracks were due to the use of too hard a jacket core, and presented so serious a problem (till he had succeeded in educating his foundry to make a proper core) that it became the alternative to utilize these defective castings or give up the enterprise. To meet this condition he devised the herein described method of closing the cracks, and as the method proved very successful for the repair of kettles that had been damaged by water freezing in the jacket, it may prove of interest to the readers of the American Machinist, and be applicable to other lines of work.

There are many thousands of these kettles in use throughout the country, and as long as there are leaky steam valves and careless men who forget to see to it that the drip cock to the jacket is open during cold weather, every winter will see a crop of burst jackets. We had occasion to repair many after others had made attempts which ran all the way from efforts to solder up the cracks to bolting on a saucer-shaped shell weighing one-fourth as much as the kettle, but in no instance was there even partial success.

A glance at the accompanying illustration will show the construction of these kettles. They are cast in one piece, the inner and outer shell being connected by a number of stays *S, S*, ¾x1¾ inches section, spaced about 4 inches centers. We successfully repaired kettles in which as many as twelve or more stays had been torn off, and in which the cracks extended fully three-fourths the way around the kettle.

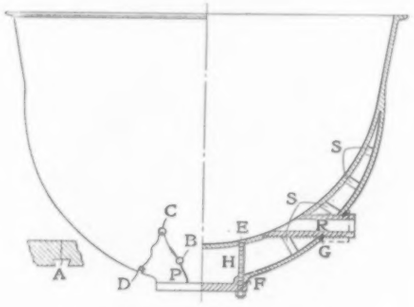
We proceeded as follows: In the first place by light taps of an ordinary machinist's hammer, delivered carefully along the various cracks we forced the pieces as far as possible into their original position. We next drilled a number of holes along the cracks with their centers in the cracks and spaced about 4 inches apart. These holes were drilled right through both shells, and care was taken to have a hole at each end of a crack to prevent its extension farther. These holes were next countersunk both on the inner and outer shell. Through as many of these holes as was found necessary, machine bolts, with rather large washers were put in. These bolts were drawn down as tightly as possible so as to bring the loose pieces as nearly down to a solid bearing as was possible, and to force the edges of the cracks closely together. A stay-bolt tap was now run through the holes unoccupied by bolts, care being taken that there was a full thread in the holes in both the shells. We commonly used 5/8-inch stay bolts, but at times 3/4-inch. An ordinary bar-iron stay bolt was now screwed in, but not only was care taken that it had a full clean thread, but after the oil had been carefully wiped off, it was dipped in a strong solution of sal ammoniac to which some raw muriatic acid had been added so as to insure a rust joint between the shells and the bolt. After cutting off the surplus length at both ends the bolt was riveted till it filled the countersink. On the inner shell the bolts were always trimmed down so as to leave a smooth surface on the outer shell; this was only done when a show job was desired. The machine bolts were now removed, and replaced by stay bolts after tapping the holes. We now have the pieces firmly back into place and securely bolted and riveted to the solid and uninjured inner shell. So far nothing is required except what any ordinary skilled mechanic can do. The next step, however, should be attempted only by one thoroughly master of the use of hammer and chisel. With a narrow cape chisel a narrow dovetail groove about 1/16 to 3/32 inch deep and 3/16 to 7/32 inch broad is next cut, carefully following the cracks, as shown at *D* and *A*. These grooves were cut part way into the heads of the bolts, as at *B*.

Next copper strips of proper thickness were carefully annealed and inserted into these groves. With a light peen-hammer these copper strips are now peened down to fill the grooves, the peening being followed by a flat calking tool. The surplus copper is nicely trimmed off and the job is done.

We subjected these repaired kettles to 100 pounds only cold-water pressure, whereas we subjected new kettles to 130 pounds to 140 pounds cold-water pressure. We guaranteed repaired kettles safe with 60 to 65 pounds steam pressure, which is ample for most purposes. When the cracks were extensive we usually put a ring of stay bolts around the opening left by the coreprint and closed by a blind flange. As shown at *H*, we left these bolts long enough to take a nut to bolt down the flange.

At *E* is shown the countersunk head on the inner shell, at *P* and *F* the copper insert, while *C* illustrates the stay bolt at the end of a crack to prevent farther extension of same.

At *R* is shown the application of the same principle to making a joint. We were to furnish a kettle with a horizontal 1½-inch outlet so placed as to empty the kettle to within 3 inches of the bottom. Ordinarily we would have cast a special kettle with a boss as indicated by the dotted line, but as we were driven by orders and had a kettle of the required size in stock, we determined to risk failure, especially as the particular size was at times a very slow seller. We first drilled a hole through both shells, and with a portable boring and thread-cutting



REPAIRING CRACKED KETTLES

machine we enlarged these holes and cut a continuous thread, or rather what would have been a continuous thread had there been stock. Not only did we pass through the empty steam space, but not a single thread in either shell was of a full circumference in length. We next turned up a sleeve 1½-inch bore and about 2½-inch outside diameter of as soft cast iron as we could procure. A continuous thread was cut on this sleeve and it was screwed into place so that the proper bevel of the inner end could be marked. It was removed and cut, leaving about ¼ inch excess stock. The hole in the inner shell was chamfered or countersunk by means of a chisel and file. The sleeve, after being moistened with a solution of sal ammoniac and muriatic acid, was screwed into place. With a light cross-peen hammer, followed by a flat calker the end of the sleeve was spread until it filled the chamfer of the hole, and was so nicely trimmed that it was impossible to see the joint. At the outside shell a dovetail groove was cut, partly in the sleeve and partly in the shell. Now a copper insert *G* was calked in. To make sure of a tight job we tested with 160 pounds cold-water pressure.

We used the same method in repairing steam pipes that had been damaged by water freezing in them. In this case we first closed the cracks or splits as far as possible, by peening before cutting the groove. This repairing can frequently be done without removing the coils from their places. We used a steam radiator for over 15 years, that had been thrown onto the junk heap as useless, after spending a little over a half-day's work in repairing it by this method. If, however, this method is to be employed to repair large pipes subjected to pressure, I would recommend putting a stay bolt at the ends of the crack through to the other side. Then wind the pipe with galvanized wire after the manner of wire-wound guns. This wire should be wound on with considerable tension, and should extend about one-third the length of the crack or split beyond either end thereof. Five or six convolutions at each end should be soldered in the manner of dynamo armatures.

This method of repairing damaged steam apparatus is efficient, but I have never seen it used by anyone else.

Use of Nickel Steel in Bridge Building

In an interesting paper read before the American Society of Civil Engineers, J. A. Waddell contributed some valuable material to the prominent subject of using nickel steel in bridge building. Summarizing from the results of his experiments, covering a period of five years, he pointed out that nickel steel is in every way fitted for bridge construction, in that it is strong, tough, workable and reliable; moreover, its adoption would effect a decided economy. This economy would increase in the future as the cost of nickel decreases, and as the shops become more accustomed to the treatment and handling of the new alloy. That nickel will soon be less expensive is almost a foregone conclusion, in view of the enormous deposits of nickel that have been found in existence in Canada. It is stated on good authority that there has been found in one deposit in that country ore containing fully 200,000 tons of the metal, and the outlook for an enormous supply is bright.

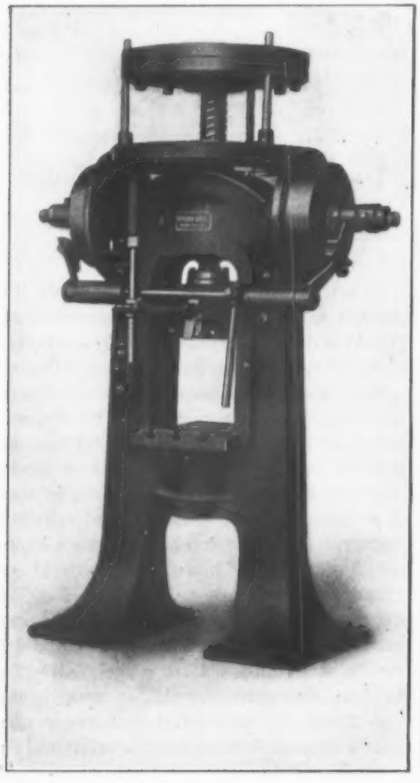
A fact that seems to have been established with reference to the relative cost of operating steam and electric locomotives is that it takes 30,000 miles of running to wear down the tires of an electric locomotive 1/32 of an inch, whereas under exactly similar conditions the same amount of wear takes place in from 8000 to 9000 miles of running on a steam locomotive.

German Friction-spindle Presses

Safety Flywheel, Improved Friction Driving System and a New Type of Brake Permit of a Light, Cheap and Successful Design

BY I. W. CHUBB

The machines known as friction-spindle presses used very extensively in Germany, and to a somewhat smaller extent throughout the rest of the continent of Europe generally, for forging and stamping purposes are not, it is thought, so well known in America. Their chief advantage is, perhaps, the ability to cope with differences in the thickness of materials to be operated on without danger of breakage, so that lighter and cheaper presses can be employed than would be the case if the machines were driven more positively.



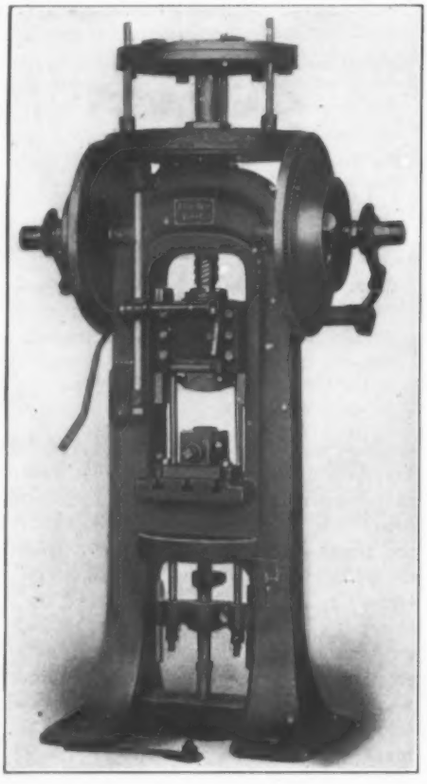


FIG. 1 GERMAN FRICTION SPINDLE PRESSES FIG. 2

The presses, of course, give an elastic blow, and, in comparison with hydraulic presses and steam hammers when used for general forging often have the advantages of smaller running costs and foundation expenses.

The firm of Brüder Boye, Berlin, has lately improved its presses, especially in connection with the safety flywheels. The driving system has also been redesigned. Two forms of their presses are shown in Figs. 1 and 2; the first is for general forging and stamping, the second for bolt- and rivet-heading.

The Flywheel Construction

The newer flywheel, constructed on the Schull system, is shown in section in Fig. 3. Here the hub *A* carries arms bearing a ring. To the latter are fastened two outer rings *B* and *C*; segments of fiber are interposed, and a rim is thus built up and secured by means of the bolts *D*. In order to avoid any danger of overstress, the bolts can be driven only by special safety keys. These take the form of Fig. 4 for the larger presses, and of Fig. 5 for the smaller sizes. It has been found possible to increase safely the speed of the spindle when the flywheel is thus constructed. As some evidence of this, Fig. 6 is given by the makers; the two sets of views showing, respectively, the extent to which a cylinder of cast steel could be safely pressed—on the left-hand with the ordinary press, and on the right-hand with the same press after being equipped with this flywheel device.

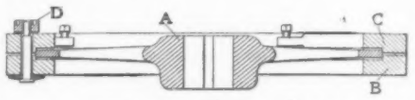
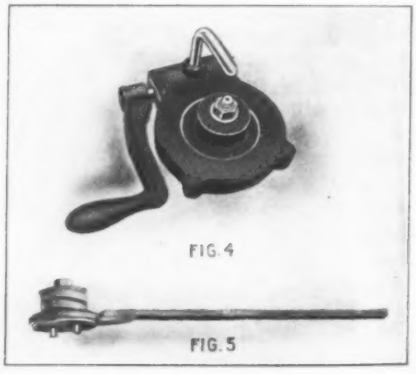


FIG. 3. SECTION OF "SCHULL" FLYWHEEL



SPECIAL WRENCHES FOR FLY-WHEEL BOLTS

FIG. 6. COMPARISON OF WORK—PRESSES OF OLD AND NEW DESIGN

The Driving Mechanism

In the ordinary form of press the flywheel serves at the same time as a driving pulley. The driving system must, therefore, be arranged above the press, and in controlling the latter a considerable amount of weight has to be moved. Moreover, in setting the press or renewing any of the parts, the work is comparatively difficult. In the new Brüder Boye presses, the flywheel is used only to accumulate and return energy and the driving pulley is separate, as in Fig. 7. This pulley is connected to the flywheel by means of pins *A* which pass freely through holes in the rim. With vertical movement of the ram the flywheel itself is correspondingly raised or lowered, but the driving pulley always remains at the same hight, and thus opportunity is given for an improved driving system. The pulley is friction-driven by belt pulleys *B* and *C*, one on each side on fixed shafts. The control of the press is, therefore, simplified as compared with the earlier system where long levers and links were necessary. The movement of the control lever *D* is transmitted through the segmental gear *E*, of which another view is shown at the side. The design of the second

segments *F* and the cam device *G* is shown in detail in Fig. 8. By springs the two pulleys *B* and *C*, Fig. 7, are kept out of contact with the driving pulley. They are put in position for driving by means of the cam surfaces which produce endwise motion. As the segment levers are secured on the pulley shaft by clamping, it is always possible to adjust their position for efficient driving.

The Braking Device

The machine has been further improved

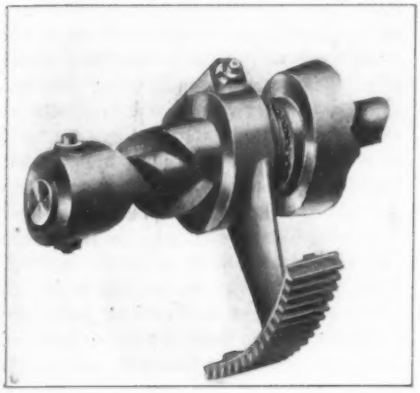


FIG. 8. SEGMENTAL GEAR AND CAM

in the braking device. This is illustrated in Fig. 9. A lever *A* on the ram controls a lever *B* on the shaft *C* which bears the brake *D*. This is covered with leather at *E* and acts on the inner rim of the driving pulley. The position of the lever on the shaft can be set by means of the clamp, and the leather cover on the brake can be easily renewed by removal of the screws. The brake is shown in detail in Figs. 10 and 11. The position of the lever sets the place at which the ram shall be stopped, and it is said that the working of the brake is so accurate that the ram can be pulled up to 1/16 inch on the pulley. It is, therefore, possible to use the shortest strokes with precision.

Finally, in connection with the press illustrated in Fig. 2, the heading tool, shown in Fig. 12, is used. This can be shifted by means of a handle so that at the second stroke the second tool is used for finishing the head.

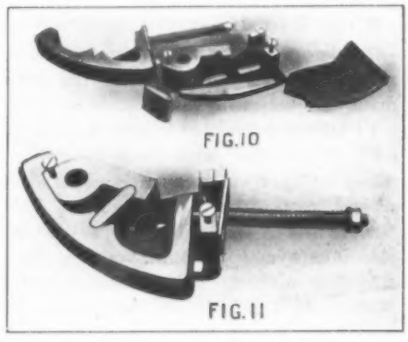
Making Manganese Bronze

By K. Kinn

Manganese bronze is the best known and the most extensively used of the high-tensile alloys. It is not a bronze, according to the old idea of the term, but a brass, being an alloy of copper and zinc, while a bronze is an alloy of copper and tin.

It has received the name bronze, and as such it will probably always be known, as the term manganese bronze sounds better than would manganese brass. The word brass to the trade, particularly the scrap-metal end of it, is associated with cheapness, as brass is less costly than bronze, zinc being a more humble metal than tin.

Every brass founder knows how to make manganese bronze, or thinks he does, but there are few who can make a really good alloy, a metal that will cast



DETAILS OF BRAKE

sound to the heart when cast in sand. There is no secret about its composition, as the proportions of copper and zinc are well known, or can easily be discovered by analysis, and yet there may be a wide difference between two alloys apparently made from the same formula. While one may possess a tensile strength of from 60,000 to 80,000 pounds, the other may be no better than ordinary brass.

The cause of this lies in the fact that extraordinary care is necessary to obtain

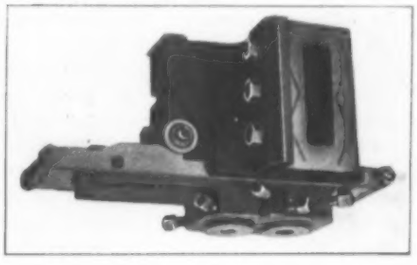


FIG. 12. HEADING TOOL

the highest results with this metal. It cannot be made like ordinary brass or bronze where the copper may be melted down, with no particular pains to prevent oxidation beyond scattering a little charcoal on top.

Deoxidization

The copper must be thoroughly deoxidized, as the purer it is and the freer from contamination by oxygen and other gases, the stronger and the better will be the resulting bronze.

Manganese is a good deoxidizer for which reason it is used in this alloy rather than for the purpose of forming

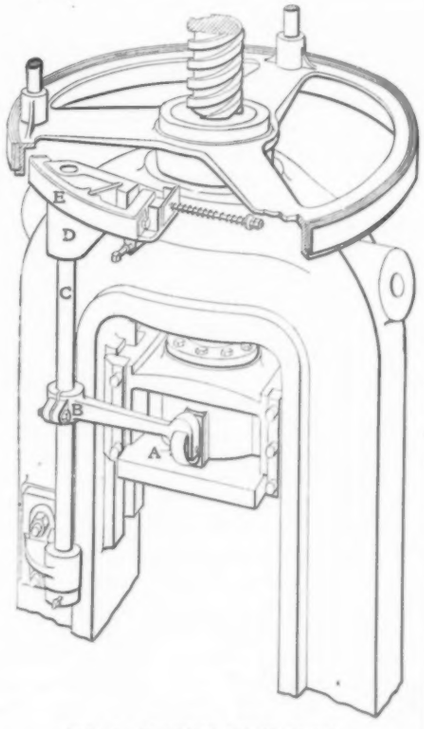


FIG. 9. BRAKING MECHANISM

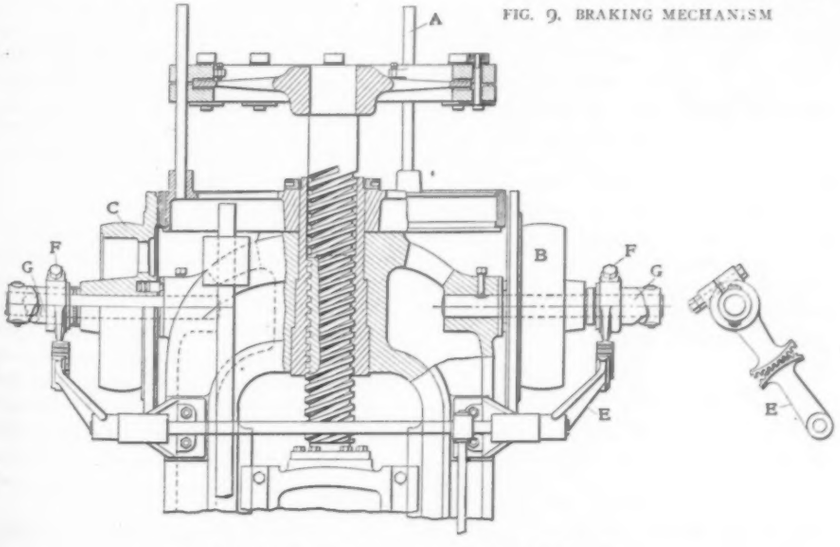


FIG. 7. DRIVING AND CONTROL MECHANISM

an alloy with the copper. It is not the quantity of manganese present that makes the metal strong, but the purity of the alloy.

Some of the best bronzes contain only a trace of manganese when analyzed. In fact some so-called manganese bronzes contain no manganese at all, the alloy being deoxidized by some other element, such as magnesium, silicon, aluminum, iron, sodium, calcium and even phosphorus alone, or in connection with magnesium.

Experimental Alloys

To determine the relative values of various deoxidizers in high brass the writer made the following experimental alloys:

First, 100 pounds of copper was melted and deoxidized with magnesium and phosphorus, 8 ounces of five-per cent. phosphor tin, and 1 ounce of magnesium being used. The copper was run into ingots, and 55 pounds of this copper was then melted, under charcoal, and 40 pounds of zinc alloyed therewith. The result was a very strong metal which ran well and made nice appearing castings.

A test bar was cast from this, eight inches long and one inch square. This bar was nicked on one side midway between the two ends, and broken with a sledge to permit an examination of the fracture. This showed a yellowish dot in the heart of the bar, and radiating therefrom to the outside were faint yellowish streaks. It was regarded as an excellent fracture, considering that the bar was cast without any of the precautions usual with manganese bronze test bars.

In a second alloy 100 pounds of copper was melted under charcoal, and deoxidized with yellow prussiate of potash in the following manner: One and one-half pounds prussiate was mixed with ½ pound soda ash, 2 ounces salt (sodium chloride) and 1 pound of ground charcoal. This was added to the melted copper, and the fire allowed to draw for a few minutes, or until the water of crystallization was driven off the potash, after which the flux was vigorously stirred in, and the furnace again closed for fifteen minutes. The metal was then removed and poured into ingots.

Testing the Alloys

A couple of castings were made in sand molds to determine if the copper was deoxidized; had it not been the metal would have boiled up in the heads, and the castings would have been spongy. This was not the case, however, for the heads shrunk down in a normal manner, and the castings proved sound. The copper was, therefore, considered deoxidized.

In passing it may be remarked that copper so deoxidized has been found valuable in making castings for electrical requirements, such as cast contact fingers, and other copper parts of controllers for electric cars, as it does not pit or arc.

Fifty-five pounds of this copper was melted and alloyed with 40 pounds of zinc, and the same sized test bars cast as that in the preceding case; the result was a fracture that had a faint yellow center with no radiating yellow lines, but here and there were specks of yellow. The alloy was strong and stiff, ran well and the castings had a pleasing brown color.

This alloy might be regarded as a "Delta metal" and given a small percentage of lead would form "Tobin bronze." The yellow prussiate of potash conveys iron into the mixture, and is one of the best means of alloying this element with copper alloys.

Manganese as a Deoxidizer

A third alloy of the same proportions of 55 pounds of copper and 40 pounds of zinc was next tried, and this metal was deoxidized with manganese, added in the form of manganese zinc. The manganese zinc was made by melting 5 pounds of manganese copper and gradually adding thereto 10 pounds of zinc. This forms a brittle alloy and is a very convenient means of using manganese in the brass foundry.

The formula used in making the test bars was: Copper, 53 pounds; manganese zinc, 6 pounds, and zinc, 36 pounds. This is also a nice casting alloy and very similar to the prussiate of potash formula; the fracture of the test bar was a reddish brown color, with a small yellow spot in the center, in the heart of which was a tiny shrink hole. None of the above alloys was pulled for tensile strength or elongation, the object of the trials being to determine the value of the various deoxidizers in eliminating the oxide spots or discolorations, which occur in the heart of most manganese-bronze castings, and which are sources of weakness.

It was decided from a careful comparison of the different fractures that the alloy deoxidized with phosphorus and magnesium had a slight advantage over the others in that respect. The metals used were not the best. The copper was scrap trolley wire, and the zinc ordinary commercial spelter. Had the best Lake Superior copper and Bertha zinc been used, it is highly probable the spots which showed up in the fractures would have been entirely eliminated.

When the three alloys were melted together in equal proportions, bars were cast which showed no spots. This demonstrated the importance of a thorough deoxidization of the alloy in making high-grade manganese bronze.

Effects of Aluminum and Silicon

It will be noticed that the alloys mentioned contained no aluminum, as is usually the case with such bronzes. This metal is added to better the casting qualities of the alloy, which it does by preventing "cold shots" in the castings. When aluminum is used 1 per cent. is sufficient, as the use of too great a quantity of this metal causes brittleness. For instance, an alloy of copper, 56 per cent., zinc 36 per cent., manganese copper 5 per cent., and aluminum 3 per cent., will be found to be brittle; but if the aluminum is reduced to 5 ounces the mixture is strong and reliable. The addition of a little tin may be recommended to stiffen it, as the zinc content is low. One half of 1 per cent. of tin is an improvement.

Silicon was tried to see if it was not better than aluminum as an addition to these alloys for improving their sand-casting qualities. The three alloys mentioned were tried with both silicon and aluminum, and the result satisfied us that silicon was superior in some respects to aluminum. While these alloys ran well in sand, they cast like yellow brass, smoking freely, consequently they are more difficult to handle when pouring off.

If aluminum is added the metal acts like melted aluminum at a red heat. It does not flare, can be poured with little or no smoke, and is, therefore, more easy to cast. Silicon has about the same effect in these copper and zinc alloys. The metal runs just as fluid and presents the same appearance, both in the liquid state and when cast, and it has the advantage over aluminum in that the metal is more free from shrinkage cracks and dross, while it is quite as strong. About two per cent. silicon copper should be used for this purpose.

Effects of Iron

Iron, as we have seen, acts as a deoxidizer and is very similar in its effects to manganese, but it cannot be used in copper alloys to the same extent that manganese can because the metals, copper and iron, do not unite to form alloys, while copper and manganese do. In small quantities properly alloyed iron is not harmful when introduced by the yellow prussiate of potash. In the example given, the alloy is difficult to distinguish from the one containing manganese. The content of iron in this alloy was about three-fourths of 1 per cent., and it was evidently chemically combined. When the iron is added in the metallic state the result, to my mind, is dubious, and it would be better to leave it out.

A favorite manner of alloying iron is to make a mixture of ferro-manganese, iron and tin, which can be added to the copper. An example of this class of alloy is as follows: Fifty-six and one-quarter per cent. of wrought iron is melted with 16¼ per cent. of 80-per cent. ferro-manganese, and then 27½ per cent. tin is added, and the metal poured into ingots. The bronze consists of 56½ per cent. copper, 43 per cent. zinc, and ½ per cent. aluminum, to which is added 2 pounds of the iron alloy.

As the melting point of this iron alloy is high, a small portion of the copper, say

10 pounds, is first melted, the iron mixture is then added and the whole superheated until the more refractory metal is dissolved. The same method must be adopted when ferro-manganese is used in making bronze in place of manganese copper. When the iron is dissolved the balance of the copper is added gradually, so as not to cause solidification of the already melted copper, and when all is "down" the zinc and aluminum are introduced.

Conclusions

In these examples of alloys the idea is that it is the iron which gives the bronze its valuable properties, the manganese acting merely as a carrier for the iron; consequently the content of iron is comparatively high and the manganese low. Later experience with these metals has shown that it would be better if these conditions were reversed, as the manganese is more important than the iron, owing to its being the more indispensable metal of the two.

Great care is necessary in weighing out the various metals which comprise this alloy, or the bronze will be brittle. This holds good of all alloys in which the zinc runs up to 43 per cent., as the margin of safety is small. One maker told me he found it necessary to boil his metal, otherwise it would be brittle and the question I naturally asked was why he put in so much zinc if he was obliged to boil out some. Alloys containing this high percentage of zinc can be, and are made, and they give the highest results in tensile strength. A softer bronze, however, is safer for the founder not experienced with this metal, and from 36 to 40 per cent. zinc is recommended as giving most certain results where the metal is run direct into castings. With the higher percentages the alloy should be first put into ingots and remelted for castings.

A line of re-inforced concrete 30-foot telegraph poles has recently been placed in experimental service by the Pennsylvania Railroad at a point on its system.

The Cutting of Elliptic Gears

By Warren E. Thompson

Elliptic gears are in general use on shapers, planers, slotters and similar machine tools to transmit a quick-return motion to the ram. The cost of production is more than for gears having circular pitch lines, but they are undoubtedly the cheapest quick-return motion among known mechanical movements. The method to be outlined is not new, but is as accurate as any and the cost of the tools is not high. This method is in general use in many shops to the exclusion of other methods not considered as good.

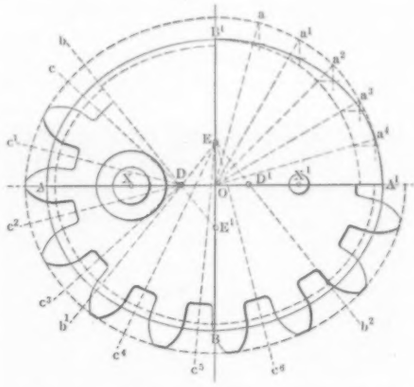


FIG. 1. LAYOUT FOR AN ELLIPTIC GEAR

In order to more clearly describe the process it will be well to take an actual case and carry it through from start to finish. Assume that a pair of gears is ordered to transmit a 3 to 1 quick-return motion and the centers are 8 inches apart. About three diametral pitch is specified.

Method of Laying Out

Fig. 1 represents diagrammatically the method of laying out the gears. Lines $A\,A'$ and $B\,B'$ are first drawn perpendicular to each other. The major axis of the pitch line of the gear is the same as the given center distance, 8 inches, and is laid off as shown. The focus points $X\,X'$ are drawn in so that $A\,X$ is in the same ratio to $A'\,X$ as the given quick-return ratio. The points B and B' are located by setting the dividers at one-half the major axis $A\,A'$ and cutting the minor axis with arcs having centers at X and X'. Arcs having radii equal to $O\,B'$ and $O\,A'$ are drawn covering one quadrant, as shown. This quadrant is divided into six equal divisions, as shown by radii from the center O. These radii are marked a, a^1, a^2, etc. Next intersecting lines are drawn from the intersection points of a, a^1, a^2, etc., with the circles, as shown, and the intersection points of these perpendiculars are points on a perfect ellipse.

With a center on $A\,A^1$ find an arc that will very nearly cut the points from a^4, a^3, a^2 and A^1. Also find a center on $B\,B^1$ about which an arc can be drawn cutting points B^1, a, a^1 and a^2. These centers are used when cutting the teeth and should be laid out as accurately as possible. After finding two centers and measuring the respective distances from O, the other two centers may be put in and an ellipse drawn, as shown. This line is then stepped off with dividers set at the corrected tooth thickness for the desired pitch and the number of divisions noted.

It is preferable to have an odd number of teeth for convenience in cutting, so if the pitch line does not divide into an even number of divisions, half of which is an odd number, when the dividers are set to the chordal-tooth thickness of the desired pitch, the pitch line may be reduced or enlarged, as is found necessary. When the pitch is given, as it was in this case, the pitch line may be divided and the divider division measured. The corresponding pitch is used in selecting a cutter. In this case the line was divided into 30 divisions and the corresponding pitch was very close to 2¼, so these cutters were used.

Radial lines common to two centers of the elliptic arcs are drawn, as shown at b, b^1, b^2, and in the other quadrant not drawn. These lines are the dividing points between two different arcs and are drawn before laying out or cutting the teeth. Radial lines from the four centers

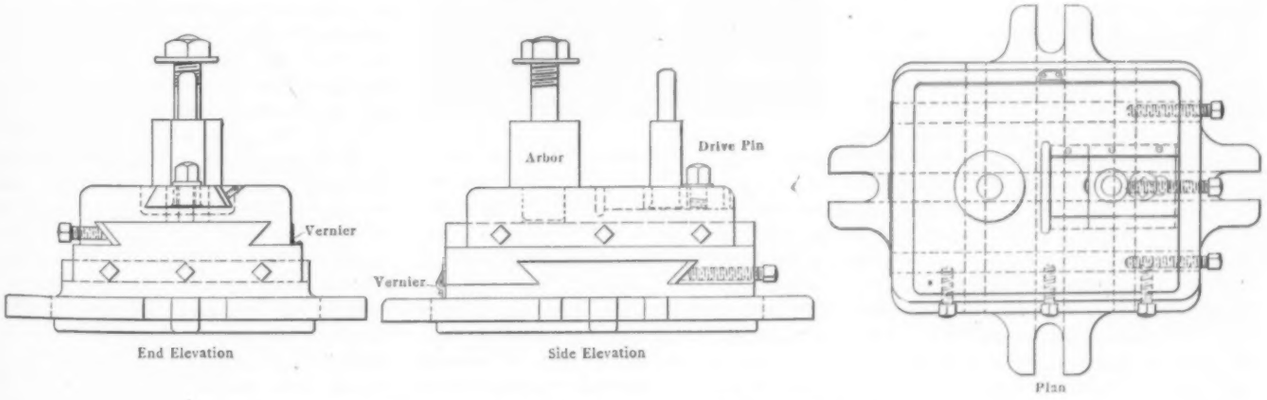


FIG. 2. FIXTURE FOR CUTTING ELLIPTICAL GEARS

are drawn through the centers of the space divisions, as shown at c, c^1, c^2, etc. These lines are for the purpose of starting the first cut and checking the rest to prevent large errors.

The base circles of the two different curves are drawn, as shown, and a few teeth laid out by an accurate odotograph on each curve, as shown, or cutters may be selected by measuring the pitch radii $D\,A$ and $E\,B$ and figuring the proper number of teeth to cut for. Cutters are selected by one or the other of these methods and the gear, previously having the shaft and driving pin holes X and X^1 bored and the addendum outline roughed, is ready for cutting.

Method of Cutting

The fixture shown at Fig. 2 is bolted onto a circular milling attachment. The fixture consists of a base plate carrying two slides moving at right angles to each other. These slides are equipped with verniers registering zero when the center of the arbor is in line with the center of rotation of the milling attachment. The drive pin is riveted into a separate slide that is adjustable and is in line with the arbor and line of motion of the large slide. This fixture is placed in position on the machine and the rough-gear blank clamped in place.

The point D^1 is then set over the center of rotation of the attachment by means of the verniers and the center of the cutter brought into the line $A\,A^1$. In this case the cutter is an end mill used to finish the outside of the gear. By moving around each quadrant setting the corresponding centers over the center of rotation for each quadrant the outside is milled true with the pitch line. A cutter for the ends is then put in the machine and in line with $A\,A^1$. The first space may then be cut to depth with two or more cuts, depending on the tests for alinement. A piece of glass having a center line and a number of short lines scratched equal distances apart and from the center line is used for testing the cuts. The center line is placed over the line $A\,A^1$ on the first cut, and the short lines brought intersecting the pitch line. By using a glass a variation of 0.001 inch may be readily seen and remedied. After the first space is cut the gear-tooth calipers may be set and used to check the cutting. By checking with both the radial center lines and the tooth calipers errors are reduced to a minimum. After the first gear is cut it may be used as a templet for all others, or the indexing may be noted and repeated.

In these days of high-speed machinery and tools, the quality of the lubricant is of large inportance, as it is known that there may be, for instance, a difference of as much as 5 per cent. in the efficiency of an engine by using an inferior grade of oil.

A Progressive Chinese Machinist

By James F. Hobart

The waking up of China having become something of today instead of a future possibility, it is of great interest to American machine manufacturers to become advised of the probability of educating natives of China to act as salesmen, erectors of machinery and demonstrators of machines and mechanical processes. Although Japan will undoubtedly do a majority of the "waking up," American machinery and tools will be supplied to that country in enormous quantity during the next 100 years.

CHARLES P. SING

Perhaps there may be no better method of placing before machine manufacturers the possibilities in the direction of educating native Chinamen to machine erection and demonstration, than by relating a bit of personal experience in that direction. During the promotion of a company for manufacturing sand-lime brick in China, it was thought best to prepare a native of China for the position of manager of the prospective factory, and to teach him the construction, erection and operation and maintenance of all the machinery likely to be used in the factory in question.

After a little searching, a young man was found who gave evidence of being capable of filling the position. This young man is known by the American name of Charles P. Sing, but the Chinese words in the corner of his portrait, presented herewith as Fig. 1, state to those able to read them, that his name is: "Ng Yee You." The two characters at the top mean five, and person, or man (Chinese writing always reads down, beginning at the right-hand upper corner), hence the name of a Chinese person always commences with the "tong," or company to which they belong. After that, come the family and the marriage names. No Chinaman is given a name until he is married. Until that time, he is known merely by his "baby" name, which is dropped when he takes a real name at the time of his marriage.

Mr. Sing was born near Canton, China, in 1873, and completed his school life at 16 years of age. When 18 years old, he was brought to this country by his father to learn the American ways, and he accomplished the task in a most excellent manner. As he became accustomed to American matters and things, he went into business for himself, his father returning to China after a few years, and the young man became in turn the proprietor of a laundry, then a restaurant, and then part owner in a store, stockholder in a Hongkong drug company, in a Chinese railway, and in several other mercantile ventures.

Mechanical Ability Crops Out

Both in the laundry business, and when running a large restaurant his mechanical ability manifested itself in doing the electric wiring of his various places of business, doing the piping and plumbing, also the carpentering, painting and papering. He even built a house or two for some of his countrymen, doing almost the entire work by himself or with the assistance of one or two "Chinaboys." And the work was done in a manner satisfactory to the various city inspectors who keep an eye upon such matters.

During the year 1906, Mr. Sing tried to obtain a position as apprentice in several machine shops and in April, 1907, he entered the Willoughby, Ohio, shops of The American Clay Machinery Company, and was assigned to floor work, erecting brick presses. In less than two months he was sent out with another workman, an erecting engineer with the largest press ever made by that company. During three months spent setting up and operating the new machine, Mr. Sing actually learned, not only the operation of the brick-press, but the method of operating every machine in the factory.

Returning to the home shop again, Mr. Sing was employed upon general floor work, including the lining up of the presses, setting the molds and surface-grinding the liners and die plates on both wet and dry grinders, and he became proficient in pneumatic tool work; in precision work, including the use of the micrometer; in pipe fitting, and the multitudinous "tricks of the trade," which

go to make up floor work in a shop where manufacturing by the duplication of parts method is not followed up.

Chinese Rules

Some of the difficulties met with in becoming accustomed to American measurement standards may be appreciated when it is understood that China uses a decimally divided foot and inch. The stumbling blocks in the shape of such things as 3/32, 9/64 inch and similar quantities may well be imagined. Another thing which Mr. Sing had to acquire was precision of measurement. Accustomed to the Chinese rule depicted at *A*, Fig. 2, imagine the attempts of a novice to work to a steel scale among 64ths and 100ths of an inch after having been educated to the bamboo guessing-stick used by the Chinese workman!

The rule shown at *A*, Fig. 2, is made from a splinter split from the side of a bamboo pole. This rule is 15¾ inches long, and is known as the carpenter's rule, and corresponds to the unit known as the foot in American practice. The Chinese plasterer or mason, by the way, uses a standard of measurement an inch or so different from the carpenter's rule illustrated by Fig. 2. To make things a bit more interesting to the workmen of different Chinese trades, the iron workers use a still different length of rule for their "standard" foot.

As all these rules consist of hand-whittled bamboo strips 15.75 inches long, and the graduations are marked with brass pins set flush with the surface in hand-drilled holes, the accuracy of the rule may well be imagined as some of the "inch" graduations vary nearly 1/16 inch from one another. There are about 364 pegs in the rule, each about 1/32 inch in diameter. To a man accustomed to working from such a measure, judge the difference when required to work to half of a sixty-fourth inch spaces. The diagram of an American rule, *B*, is given to enable comparison to be made between the Chinese and the American "foot."

A Fine Recommendation

The opinion of The American Clay Machinery Company may well be comprehended by a perusal of the following letter from the A. M. C. Co., to the agents of Mr. Sing's company:

By W. J. Carmichael,
Manager Sand-Lime Brick Department.
Willoughby, O., Nov. 22, 1907.

Messrs. Wing On Wo Company,
13 Mott Street,
New York, N. Y.

Gentlemen:

We are pleased to write you in reference to Mr. Chas. Sing, who since April 8, has been in our employ, assisting in the manufacture, erection and operation of machinery for the manufacture of sand-lime brick. We are glad to advise you that he has proven himself a most capable man and has carried out every detail of his work with a willingness, and as intelligently as we could desire. We are only sorry that the time has come when he deems it necessary to leave us in order to take up the work which he has planned.

From early morning until late at night, Mr. Sing has been fitting himself for the work of brick making in his native country and we have given him every possible assistance in our power to fit himself for this work.

After working in the erecting shop in close touch with our best mechanics and having learned all the details of our brick presses, cars, grinding and mixing machinery, etc., we placed him at work in our laboratory with a most competent man. Here, he readily took up the making of sand-lime brick samples, the hydrating of lime and acquainted himself with the causes and effects of the chemical changes produced between the sand and lime while under steam pressure.

He is now entirely familiar with the mixtures required for producing first-class sand-lime bricks of any desired color. In order to further his education in the manufacture of bricks, we sent him with our erecting and operating engineers to factories where sand-lime brick were being made daily in commercial quantities. We retained him at this work for several weeks until he became thoroughly acquainted with the operation of a large factory.

We thoroughly believe that Mr. Sing has grasped the details of our machinery so firmly in his mind that he can tear any of our machines apart and replace them in first class condition, as well as operate them while making sand-lime brick.

In closing, we would add that we have found him absolutely reliable, perfectly truthful, sober, industrious and far above the average in intelligence and adaptability to conditions. We do not hesitate to recommend him highly, in every respect, and we wish for you and for Mr. Sing, a most successful career.

Yours truly,
The American Clay Machinery Co.

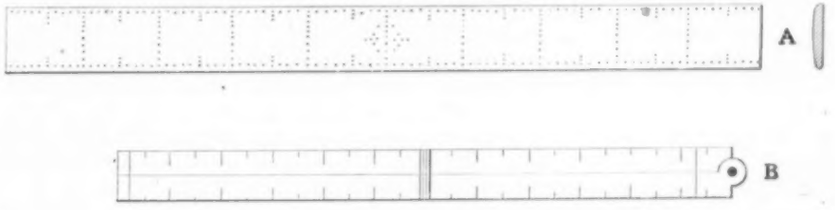
I can also add personal testimony in regard to Mr. Sing's adaptability to laboratory work, having been in charge of the tests at the time mentioned in the above letter.

Learning about Engines and Boilers

In order to add to his knowledge of factory machinery Mr. Sing entered the employ of The Hooven, Owens, Rentschler Company, and became familiar with the Corliss engine. After a very few weeks on the erecting floor of The Hamilton Corliss Engine Works, Mr. Sing was sent out with the erecting gang and set up light engines, heavy-duty engines, pumping engines, direct-connected engines, and accumulated a store of information which often requires a man half a lifetime to acquire. After completing his work with the steam-engine company, Mr. Sing took with him a letter of which any man might be proud.

Mr. Sing is now about entering a boiler works for the purpose of preparing himself to install, operate and repair steam boilers and other steam vessels when in China, thousands of miles away from repair and renewal conveniences. And it is safe to state that in six or eight months he will be competent to set up a steam boiler in the most approved manner, to insert a new set of tubes, to calk leaky sheets, and to replace a sheet or two if it becomes necessary.

The aptitude of Mr. Sing in acquiring American ways is well illustrated by his social capacity. His cue was cut off, long ago, and American dress adopted for all purposes. He also expresses the intention of wearing the American dress after his return to China. Mr. Sing is a pronounced "camera fiend," possesses a good camera and knows how to "push the button," and then do all the rest himself. He is a fine wheelman and owns and uses a high-grade 'cycle, which he keeps in order himself, making all necessary repairs and renewals.



CHINESE AND AMERICAN RULES

The progressive mechanical education which Mr. Sing is obtaining, and the purpose of which it is being acquired, is worthy of close consideration by the American machine manufacturer who desires in the immediate future to enter the almost limitless field of Chinese trade. I can place hands upon dozens of young Chinese men who could fit themselves in a similar manner to handle American machinery in China, and it is in order for the enterprising manufacturer to get busy in this direction and be early in the field. American business methods are not Chinese methods, and will not be for many years to come. Meanwhile a profitable working knowledge of both American machinery and the Chinese market can be acquired by the progressive young

Chinamen much quicker and better than by the ablest Americans, and the machine manufacturer who secures and educates a representative of that nation in the manner followed by Mr. Sing will obtain an advantage in Chinese trade which cannot be equalled by any other method.

Accuracy—A Comparative Term

By Entropy

When I was a small boy I arrived at the opinion that a machinist who could hold down a job in a machine-tool shop was at the very pinnacle of his trade. Later, I found that my opinion was subject to revision. I even came to the conclusion that less out-and-out precise work is needed in a machine-tool shop than in the average of other shops.

Let us stop a moment and see what precise work is. To a man measuring a cord of wood, a cubic foot, more or less, is of small importance. To a man who is measuring a room for a carpet an inch is easily within the stretch of his material. A man making wooden boxes ought to get down to one-eighth inch. A pattern-maker swears that he works to a hundredth, and then slops on paint enough to bring his errors up to a thirty-second. No machinist ever fails to work to a thousandth except the few thousand that still use old-fashioned calipers and work to quarter-thousandths without knowing it. The physicist works to—well, I do not know how fine, but so close that he doubts his own results and cannot make them come twice alike in succession.

Practical Accuracy

Where is the stopping point for practical work? To my mind it comes just where you can measure twice alike. That is, every bit of material that we are using is constantly changing size and shape through changes in temperature or moisture. When we begin to detect differences in measurements from one time to another, due to practical variation in temperature or moisture, it is time to stop refining our measuring system. I remember once I was trying to make a lead screw 40 feet long that would be accurate within one-thousandth of an inch per foot. That meant 0.04 inch variation in the whole length. We could easily get that much variation as compared with marks on the brick wall of the shop, between morning and noon (no knowing how much they shifted). We compromised with ourselves by trying to get the screw as nearly right as we could, between 4 and 6 p.m., when the sun was on the other side of the shop.

The average shop does not work anywhere near such a standard of precision. It is only recently that any but scientists and shop owners of a scientific turn of mind have attempted to put machine-shop practice on anything like a basis of accuracy. It is so recently that I feel safe in saying, that to half the machinists who read these pages, the really uptodate machine shop with measurements kept to standard, is a work of fiction, rather than reality. The worst of it is, the man who is accustomed to work in either kind of a shop is not worth his salt in the other.

Overrefined Accuracy

One time I was holding down a job in a machine shop which I believe was just about up to, or down to the average. We needed another man and something of that description blew in one day. I found out that he was a crack-a-jack machinist, had worked in several of the "best" shops, and in none of the plebeian variety. He very evidently turned up his nose at us and we at him, but we needed a man and he needed a job, so we struck a bargain. He had to turn some gear blanks, 8 2/7 inches was the measurement on the drawing. He spent half an hour figuring over something, before I found that he was after the decimal equivalent of 2/7. I asked him what he was going to do with it when he got it. "Set the 'mikes' to it," he said. "Got some that will measure that far?"

"No, sir," I replied, "they don't grow around here." He finally came down to earth and turned them to a scale divided in sevenths, thought it took him a long time to set his calipers and I saw him shaking his head over them several times before he finished the job.

Then he had another trouble. We had some "tail bonnets," the bearing for the tailstock screw on some 18-inch lathes. We had a tapped hole to fit the thread to, and we turned the rest of the outside by the eye till it looked good enough to polish. I couldn't find the drawing, so I gave him three, that I picked up in the tool room, for samples. A little later he came up and said, "Mr. Entropy, which one of these shall I square mine up to?" I asked him what he meant and he went off into a long explanation of how he had calipered them, and then fitted up shims and papers until he found out that one was 0.036 inch shorter than the longest one. I patiently took him over to a lathe and asked him what difference he could see in the value of that lathe if one or the other of those two bonnets was used. I showed him, what he already knew, that the nut outside the hand wheel would take up much more than the variation he had found. He saw the point and thanked me, and then told me that wherever he had worked before he had not known what any of the things were used for that he made; he worked to drawings and either snap gages or micrometers, usually working as close as he could get at other times to set limits. He owned that the chances were that he had often spent hours on work which afterward only fitted into the surrounding atmosphere, and seemed to see that our way was more likely to be economical. But he drifted away and back into his "uptodate" shop again as soon as he could.

He took with him one of our best men to whom he painted the advantage of having tools fit for a "white man" to work with. Tom came back in about 10 weeks. He was glad to get back too. "Tell you what, boys, the old shop for mine. They didn't even get to know what my name was; number 115 it was till they made it 23, and I knew enough to get out. And you don't know what you are working on over there. I had a lot of little shafts for machine F-N-16 to make. I knew they were shafts, but they called them S-253. I made them up pretty good too, there wasn't one that was over half a thousandth off, and they looked great when I piled them up on the bench. What do you suppose they did with them? They sent a fellow around from the paint room after them and he lugged them off and painted them all over. It seems they were something like a shipper rod on our countershafts."

Value of Practical Truing in Accuracy

And so the thing goes. No finer work, no better work is done in a shop where everything is done to micrometers than where they never heard of them; but some men get the craze and can never work to ordinary calipers after a few weeks with the "mikes."

Suppose a man wants to rise a little above the ranks, which shop will be most apt to put him in a position to rise; the little old shop with its pile of arbors under the bench, or the new shop with its gages and standards and measuring machines? I say the former. It is a mighty poor thing usually, from a standpoint of metal products, but its mental products can give the other shop aces and spades and then show them the way home.

It may seem rather strange, but a shop is really a good deal like a school. It doesn't teach very much intentionally that is really worth while, but its by-products are of vast importance. The most important of these by-products in the little shop is men. I recall a shop that failed several years ago. Out of the men who were getting $2.50 or more, at the time it went under, two-thirds are now foremen or gang bosses for other and successful shops. Employers who run these fine shops know too much to pick their foremen from their own men. They go out and get new blood. They want foremen who have judgment just as much as they want workmen who have no ambition to use judgment. They know just where to go to get them too.

It is reported that terms of a treaty between the United States and Germany relating to patents have been agreed upon and it is stated that the completed treaty will soon receive attention in the U. S. Senate.

Hopkinson Flashlight Indicator

It is generally admitted that for engines running at more than 200 or 300 revolutions a minute the ordinary indicator does not give satisfactory results. The inertia of its piston and parallel motion seriously distort the diagrams, while slackness of the motion joints and friction of the pencil on the paper introduce other errors which are by no means negligible. When we come to really high speeds, such as those of petrol and other engines, the only practicable form of indicator is the optical type, in which a minute motion of a diaphragm or piston, subject to the cylinder pressure, is magnified and made visible by means of a beam of reflected light. The optical principle at once does away with inertia troubles, and when embodied in a suitable type of apparatus is capable of giving valuable results at the highest speeds at which any engine can run. Very good work has been done with such indicators, which have now been in use for some years.

FIG. 1

In the usual form of optical indicator the pressure of the steam or gas acts underneath a metallic diaphragm, which is attached to a mirror. The deflections of the diaphragm cause the mirror to rock, so that a spot of light reflected from it traces out a line on the card. The objections to this form are twofold: Firstly, that the deflections of the diaphragm are not exactly proportional to the pressure acting upon it; and, secondly, that the heat of the steam or gas is likely to affect the calibration of the instrument by altering the elasticity of the diaphragm. To avoid any possible source of error or trouble from these causes, Prof. Bertram Hopkinson, of Cambridge University, has devised the instrument shown in Figs. 1 to 3, which is manufactured by Dobbie-McInnes, Limited, of 57 Bothwell street, Glasgow, and sold under the name of the Hopkinson Flashlight Engine Indicator.

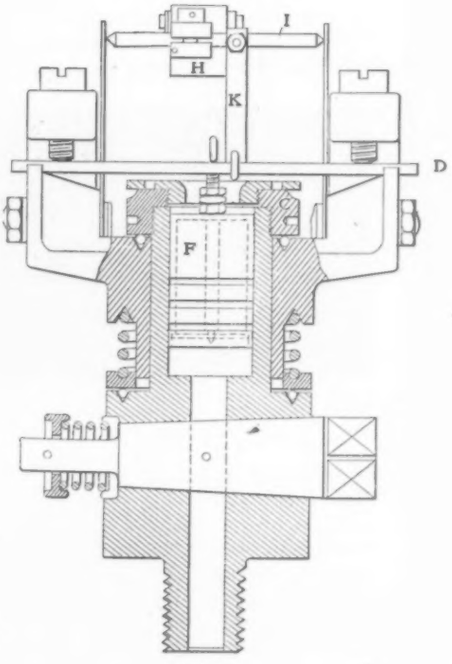


FIG. 2

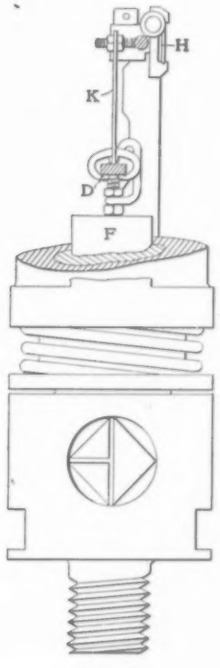


FIG. 3

The distinctive features of the Hopkinson indicator are shown in Figs. 2 and 3. The body of the instrument is bored to receive a piston *F*, the top of which is fitted with a wire-hook arrangement which embraces at the center a flat steel spring *D* fixed transversely above the piston. The hook does not hold the spring tightly enough to prevent the piston taking its position freely in the bore. The spring is clamped at each end to the rotating head of the instrument in the manner shown. Before insertion it is slightly curved, but when in position it is held straight by a moderate pressure of the two binding screws. Above the spring, and parallel to it, is a spindle *I*, to the center of which a small mirror *H* is fixed. The spindle is carried on pointed centers, against which spring clips press. It, and therefore the mirror, are caused to rock by means of a thin steel strip *K* connecting the spring and spindle, the flexibility of the strip allowing it to accommodate itself to the circular motion of the spindle. The length of the diagram is obtained by rocking the head of the instrument around the body, the motion taking place on the ball bearings shown in Fig. 2. A motion of the head through an angle of about 3½ degrees gives a diagram 2 inches long. The motion of the piston is only 1/40 inch, so that inertia effects are very small indeed. The indicator may be driven through a motion which is not illustrated, but in which an eccentric is fixed to the engine crank shaft, and a spring clip to the indicator head, although we understand that Dobbie-McInnes are prepared to supply better mechanical arrangements for most cases.

FIG. 4

To render the diagram visible, or to obtain a photographic record of it, a camera like that shown in Fig. 4 is attached to the indicator. A concave reflecting mirror is used, which throws a spot of light upon a ground-glass screen

or photographic plate at the outward end of the camera. Should no permanent record be required, the object being simply to observe the pressure at any point of the stroke, or to note the general shape of the diagram, a telescopic arrangement, as shown in Fig. 5, is used. The optical principle is illustrated in Fig. 6. The source of light is the filament of a 4-volt lamp at P placed transversely to a slit. The narrow beam thus formed is reflected from the plane mirror Q of the indicator upon the convex lens R_1, which is 4 inches in diameter, and situated about 18 inches from the mirror. The beam comes to a focus in the plane R_2. About 10 inches from R_2 is a second lens R_3, of the same size as R_1, which refracts the beam to R_4, where the eye of the observer is placed. A transparent screen, situated at R_2, is engraved with horizontal and vertical lines, on which the diagram appears superposed. Figs. 7 and 8 are reproductions of two indicator diagrams taken by the Hopkinson instrument, one from a gas engine and one from a steam engine. The diagram shown in Fig. 7 represents twenty explosion strokes, with a mixture containing about 11 per cent. of gas; that in Fig. 8 is from the low-pressure cylinder of an 11-brake-horsepower Belliss engine, running at 600 revolutions per minute. The scale of the original is about 12 pounds to an inch, and the diagram shows very well the small inertia of the instrument.

Three pistons are supplied with the indicator, their areas being in the ratio of 1, 2 and 4. The smaller ones are inserted in liners which fit into the bore of the instrument. Two springs are supplied, one five times as stiff as the other, so that by interchanging among the pistons and springs a wide range of scale is obtained. The initial strain on the springs, due to straightening out their natural curvature, allows suction pressures to be registered to the same scale as pressures above the atmosphere.—*Engineering.*

FIG. 6

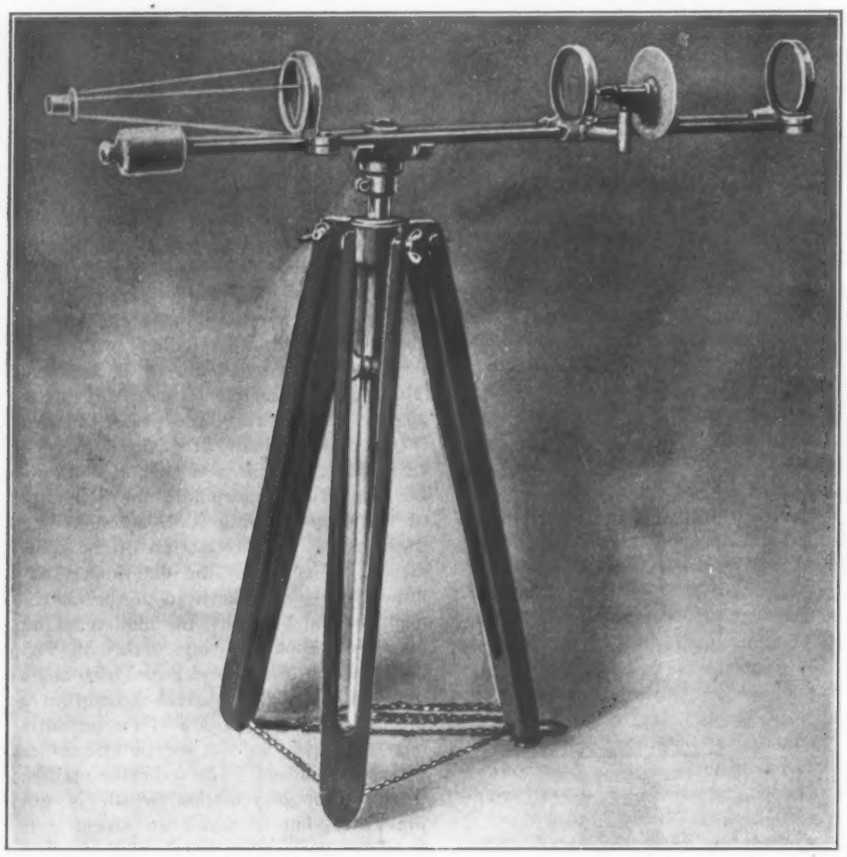


FIG. 5

Progress with Wireless Telephony

Alongside the almost daily advancement that wireless telegraphy is making comes important reports that wireless telephony is also making rapid strides in practical development. Dr. Lee de Forest made some very successful experiments in wireless telephony and is now preparing to institute a line of wireless communication between the Eiffel tower, in Paris, France, and the Metropolitan Life Insurance building, in New York City, whose hights are 930 and 630 feet, respectively. In commenting upon the project, Dr. de Forest was very sanguine as to ultimate success, and pointed as a criterion to the successful messages exchanged between New York and Colon, Panama, a distance of over 2000 miles with the use of masts only some 210 feet high. That wireless telephony promises practical success is also signified by the fact that the U. S. Government has recently let a contract for the installation of a complete plant at Washington.

FIG. 7

FIG. 8

According to a consular report very satisfactory results have been obtained from experiments carried on for a number of years in Paris with a combination asphalt and rubber pavement. It is reported to resist higher temperatures than asphalt alone and to possess more plastic and adhesive qualities.

Practical Letters from Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

A Portable Hydraulic Press

In shops building small and medium size gas engines to find a handy method of putting on the flywheels has to some been quite a problem. This arises from the fact that the conventional design of gas engine does not readily admit of the use of the ordinary makes of power presses, and also because not many shops, where engines are built in quantities, can afford sufficient room between the engines either on the erecting floor or on the testing blocks to operate such presses as the trade offers.

To overcome these difficulties I designed and built the portable hydraulic press here illustrated. The press can be operated between engines having not more than two feet between them, and as will be seen is adjustable to accommodate the different hights of crank centers.

The jack proper is one of a well known make, but shortened for the occasion, and having the ears cast on for the rods.

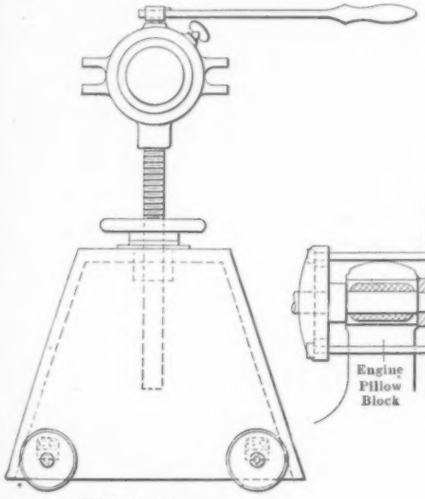


FIG. 1. End View

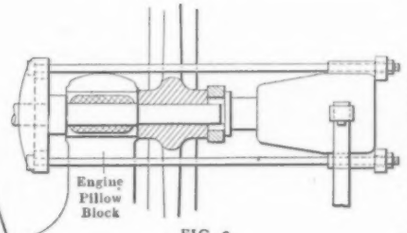


FIG. 2

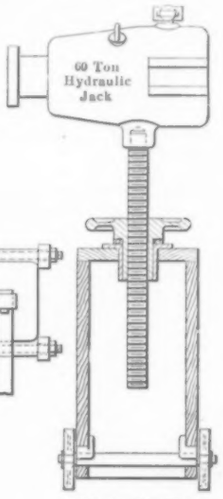


FIG. 1. Side View

A HYDRAULIC PRESS FOR GAS ENGINE FLYWHEELS

I believe the drawing is plain enough so that a description can be dispensed with.

Fig. 2 illustrates the method of clamping to press on the flywheels. The movement of the ram is necessarily short, being 6½ inches, so that with wheels having longer hubs it is necessary to make "two bites" of it. To avoid moving the nuts on the ends of the rods so far, U-shaped washers are used which can be slipped over the rods. The same is true of the collar between the ram head and the wheel hub. The rods are made of 1½-inch round swedish iron and have frequently withstood a gage pressure beyond the nominal capacity of the jack.

Cincinnati, O. J. F. M.

A Hinged Boring Bar Fixture

The half-tones show a hinged boring-bar fixture mounted on the carriage of a 27-inch Lodge & Shipley lathe and now in use in the works of Joseph Reid Gas Engine Company, Oil City, Penn. The fixture was made to overcome the trouble of removing heavy boring-bar blocks from the tool-post slot each time after boring, to give greater rigidity to the bar and to permit the bar to be swung out of the way so that an arbor could be used in the bore while finishing outside of work. The boring bar is supported in the hollow spindle of the lathe, running through the cast-iron bushing, which can be easily replaced when worn. The method of boring a hole is: first operation, a double-ended roughing cutter is run through to get under the scale and clean the hole up; second, a single-ended cutter is put in to true up the hole; third, a double-ended cutter is used, bringing the hole within 1/64 inch of size (in view shown, 4¼ inches); fourth, the finishing cutter, a floating one, is now run through completing the bore. The carriage is then backed and the bridge holding the bar is unclamped and thrown back clear of the work. An arbor is then inserted in the bore and the outside is finished.

Oil City, Penn. JOHN REID.

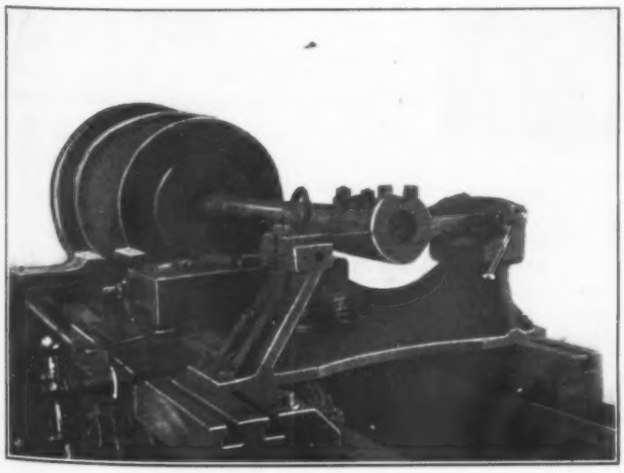


FIG. 1. HINGED BORING-BAR FIXTURE CLOSED FOR WORK

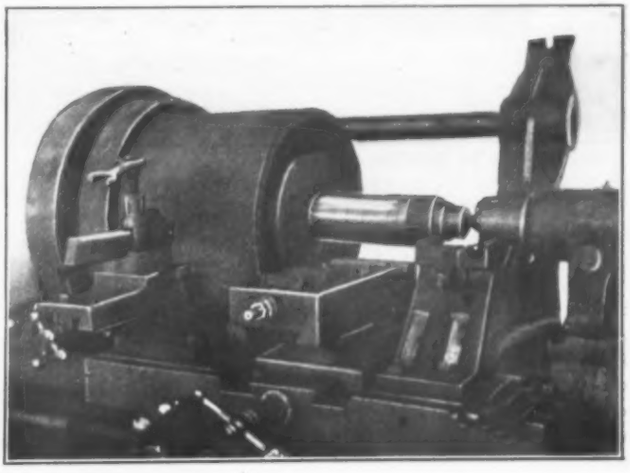


FIG. 2. OPENED FOR FINISHING OUTSIDE OF PULLEY

A Handy Milling Chuck

The illustrations show a milling-machine chuck used at the shops of the Cincinnati Planer Company, Cincinnati, Ohio, for holding shafts, screws, etc., having one or more diameters while being milled or keywayed.

Fig. 1 shows the two chucks mounted on a milling-machine table holding a shaft having different diameters and ready for the keywaying operation. The drawing, Fig. 2, shows the chuck in detail. It will be seen that it is made of two sliding V-shaped jaws having tapped holes and actuated by a screw having a right- and left-hand thread. This screw is held from moving endwise by the collar in the center which fits in a milled slot in the bottom plate of the chuck which is bolted to the milling-machine table. Care should be taken to get these slots in line with each other. This can best be accomplished by putting the bottom plates of the chucks on the table of the machine and then milling the slots while thus in place. As these bottom plates carry a tongue fitted into the slot of the milling-machine table, they can be as readily removed and replaced as any other fixture.

The V-shaped jaws are guided by the two angle strips bolted to the bottom plate, and the jaws have a sliding fit between

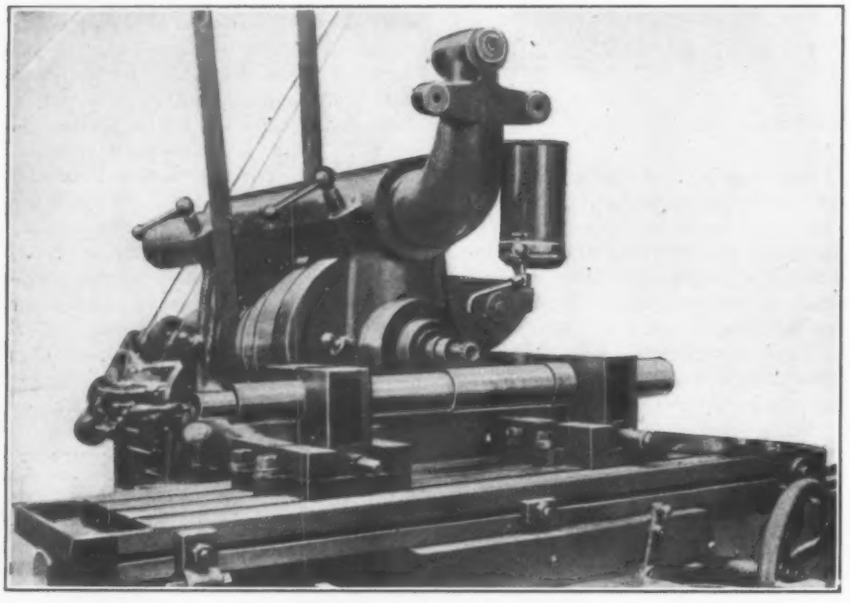


FIG. 1. MILLING-MACHINE CHUCK

them so that by applying a crank handle to the square on the end of the screw the jaws can be made to clamp any desired diameter independent of each other. This also brings the work absolutely in alinement irrespective of the difference in diameters, which by the ordinary method would have to be done by packing up a pair of V-blocks to get the desired alinement. The time thus saved is quite an item.

Cincinnati, O. CHARLES MEIER.

Making an Air Compressor out of an Old Gas Engine

We had been contemplating installing a compressed-air plant in an electrical manufactory, but from various causes the matter was allowed to drift. One day, however, the works manager seeing an old gas engine, it occurred to him that this engine could with a small amount of modification, be utilized as an air compressor.

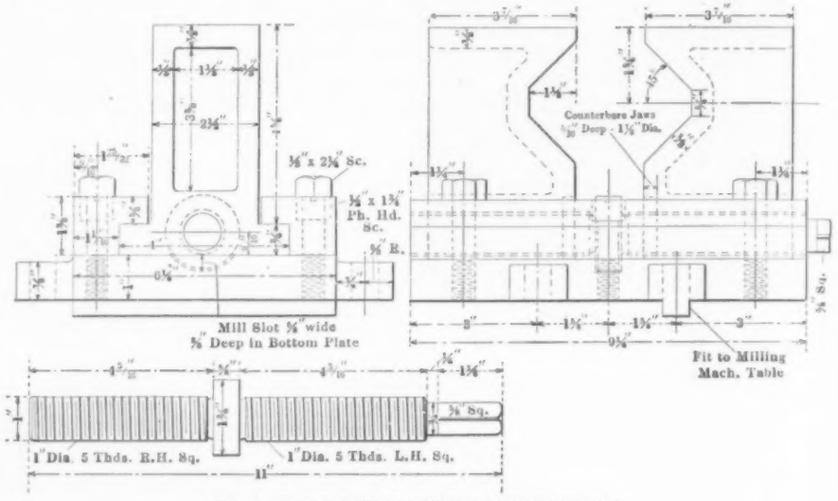


FIG. 2. DETAILS OF MILLING-MACHINE CHUCK

A cast-iron block was made and bolted to the end of the piston to practically fill up the combustion chamber in the cylinder and reduce the clearance to the smallest possible amount. The old valve gear was then removed and two plain circular flat-seated valves, held onto their seats by light springs, were fitted, one in the intake and one in the exhaust opening, forming, respectively, the suction and delivery valves. A suitable tank was also found, and tested.

The air compressor was then driven by belt from an electric motor. Not the least interesting part of the plant is the automatic starting and stopping device. Solenoid main and motor-starting switches are made in large quantities in the works, and a set was installed, and operates in the following manner: The glass front of the pressure gage on the receiver was drilled and two small brass terminals affixed. A very light brass lever is pivoted on one of these terminals inside the glass dial, one end of the lever being V-shaped, and engaging with a similar V-shaped piece of brass attached to the needle of the pressure gage. The other end of the lever moves into or out of contact with the second terminal on the glass. The wires from the solenoid main switch are attached to the two terminals on the outside of the glass, and it will thus be seen that the lever inside acts as a switch, actuated by the needle or pointer of the pressure gage. The object of making the engaging parts V-shaped is to give a quick make and break and thus minimize any sparking which may take place, though as the current in the solenoid coil amounts only to about ½ ampere, or the current required by a 110-volt 16-candlepower lamp, there is in any case very little sparking.

METHOD OF OPERATION

After pumping for some time, and the pressure in the receiver has reached about 80 pounds, the point of the V-block attached to the needle slips past the point of the V-end of the lever and raises the other end out of contact with the second terminal. The main solenoid circuit is then broken, and the iron core drops, cutting off the current from the motor, which then stops. As soon as the receiver pressure falls to about 60 pounds the needle of the gage operates in a similar way, but this time pressing the lever onto the other terminal, and thus energizing the main solenoid, which sucks up its iron core, energizes the solenoid of the motor-start-

ing switch, which, as its iron core is sucked up gradually against a dashpot, cuts out the steps of resistance from the armature circuit, until it is running at full speed. The motor continues to run, and drives the compressor until the pressure in the receiver again reaches 80 pounds, when everything comes to rest as before. This automatic starting and stopping takes place perhaps 20 or 30 times per day, and has never been touched for repair since it was put into operation about 18 months ago. Reference may be made to a further automatic device which has assisted materially in the satisfactory working of the plant. It was found when first put into operation, that the belt was very liable to come off, or the fuses blow, when the motor was accelerating the heavy flywheel, and commencing at once to compress against 60 pounds pressure. So a weighted lever was arranged at the back of the compressor to lift the suction valve off its seat when the engine was at rest and starting up, so that the piston merely sucks in air and expels it on the return stroke from the same opening, thus doing no work. For the information of those who are not familiar with the working and operation of solenoid starting switches, it may be explained that although it takes a strong magnetic pull to suck up the iron core into the solenoid, it takes very little magnetizing force to hold the core up when it has reached the end of its travel and the moving and fixed portions of iron are nearly in contact. For this reason solenoid switches are generally arranged so that an ordinary 8- or 16-candlepower glow lamp is automatically put in series with the solenoid coil when the switch arm has reached the "full on" position. This reduces the current in the solenoid coil to one-half or one-third, keeping the coil cool and economizing current.

In the plant under consideration, instead of inserting a glow lamp in series with the coil of the solenoid starting switch, another solenoid and iron core is fixed at the back of the compressor, the core being attached to the other end of the weighted lever before referred to. Thus, when the starting switch has cut out all the resistance from the armature circuit, and the motor and compressor have attained full speed, this additional solenoid is energized, sucks down the core, raises the weighted end of the lever and allows the suction valve to drop onto its seat. The piston then begins to compress air at each stroke.

Birmingham, England. R. G.

[There is a shop in Brooklyn, N. Y., where they have an air compressor made in the same way, but driven by belt from a gas engine. Some years ago we made a compressor, using an old steam engine and ran it backward so that the pressure would keep the valve on its seat.—ED.]

Device for Controlling the Hight and Travel of Hydraulic Accumulators

When hydraulic machinery requiring high pressure is installed, there is generally an accumulator in the installation which is loaded with ballast to give the required pressure. The pump and accumulator are connected to the pressure line, as shown in Fig. 1. In press work the quantity of water used is variable, and it is necessary to control the hight of the travel of the accumulator and to stop it

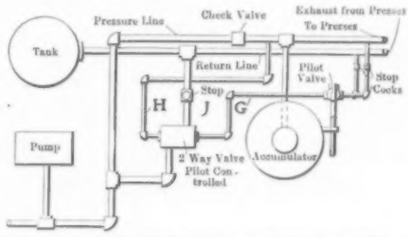


FIG. 1. PLAN OF PIPING FOR HYDRAULIC PUMP AND ACCUMULATOR

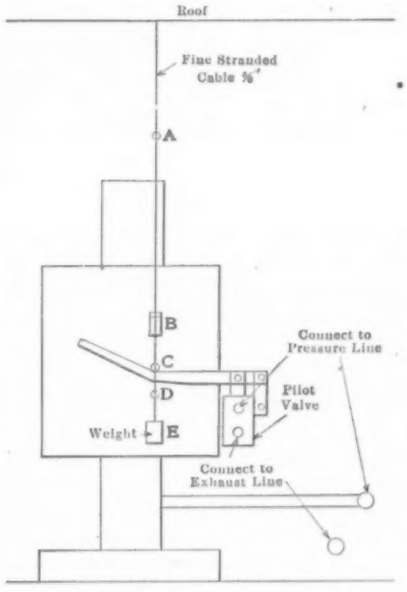


FIG. 2. ARRANGEMENT OF PILOT VALVE FOR HYDRAULIC SYSTEM

when it has reached a predetermined hight. At the same time the pump must be relieved from the pressure and thus avoid loss of power. Such controlling devices are usually operated by the accumulator; when it reaches the given hight it opens a valve which bypasses the water from the pressure line to the exhaust line; the pump then works against exhaust-line pressure only.

The trouble with most devices of this kind is that they wire-draw; i.e., they open just enough to let the water through them under full pressure into the exhaust line; the pumps are, in this case, working under full pressure and power is wasted. Wire-drawing is very hard on the valves as it cuts the seats or cups, and they soon require grinding or renewing. I have had charge of two plants, each having a different device for this purpose and both of them wire-drew badly.

The device which I will describe answers the purpose perfectly and in no case can it wire-draw. Fig. 1 is a plan of pump, accumulator, necessary valves and piping required. The pump and accumulator are connected to the pressure line with a check valve between them. Between the check valve and pump the pressure line is connected to the exhaust line, and in this connecting line is placed a standard two-way valve, pilot controlled, also a stop valve, as shown in Fig. 1. The stop cock is required for starting; in case you stop with the two-way valve open, when you start all the water will pass through it into the exhaust line, and there will be no pressure to close the two-way valve. But if you close the stop valve *J*, then you get the pressure which will close the two-way valve through the pipe *H*, which is always under pressure. After the pressure is obtained open the stop *J*.

The pilot valve is connected, as shown, and is provided with a lever which has a long slot through which a wire cable works; the cable also works through the lug *B* which is attached to the accumulator tank. The cable is anchored to the roof or any suitable place over the pilot valve; on the end of the cable is a weight *E* heavy enough to operate the pilot valve, also on the cable there are three clamps *A*, *C*, *D*, which can be moved readily and clamped securely to the cable; these are placed as shown. When the accumulator is pumped up the lug *B* strikes the clamp *A* and lifts the weight *E*. The clamp *D* also strikes the lever of the pilot valve, operating it, which opens the two-way valve, thus connecting the pressure line with the exhaust line. When water is used the accumulator goes down and the weight *E*, through the clamp *C* operates the pilot valve, which closes the two-way valve and thus completes the cycle.

The lever of the pilot valve is curved to allow the accumulator to travel to the vent holes in the ram, should the two-way valve fail to act, thus preventing damage to the pilot valve. The cable is marked "fine stranded wire line;" this is necessary on account of the bend in the line above the clamp *A* which will in time break the line unless it is flexible.

In one installation a 2-inch two-way valve operated by a standard ½-inch three-way valve for a pilot valve, controlled a 10-inch by 12-foot accumulator, the pumps delivering 175 gallons per minute at 400 pounds pressure. There was no trouble whatever with the device. The valves were cup-packed, standard stock valves made by R. D. Wood & Co., Philadelphia.

Bradford, Penn. JAMES CLARK.

A Handy Hight Gage for the Miller

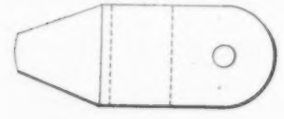
The accompanying line cut shows a very convenient hight gage for use on the milling machine. It should be made so that the lower edge of the scriber is just the hight of the centers of the machines where it is to be used.

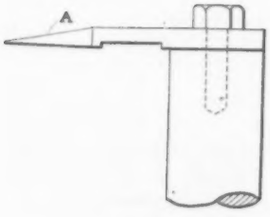
On work where one edge of the cut is required to be radial, such as milling cutters, etc., it is a common practice to take an ordinary surface gage, set it to the hight of the centers, then place the work between the centers and scribe a line on it; then by turning the work one-fourth of a turn, bringing the line on top, it is only necessary to move the saddle in or out until the straight edge of the cutter coincides with the line, and it is in the proper position. This method would be hard to improve were it not for the fact that the centers are liable to be somewhat blunt, or a man is liable to forget this part of the operation until he has the work firmly fastened in position. Of course, he can make a close guess, scribe a line on the back, turn the work half over and make another line in front; if the two lines come at the same place the gage is set at the right hight, if not, he may set the scriber approximately half way between the two lines and repeat the operation for proof.

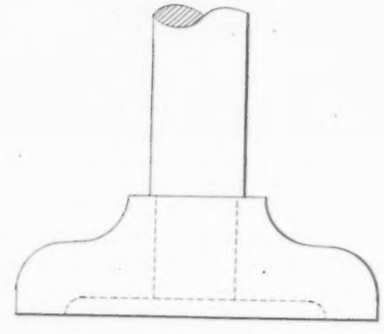
If one of these gages was placed in a convenient place near the machine it was made for, it would save much time in setting up work as it is always right the first time.

In making a gage like this care should be taken to get the standard just the required hight from the bottom, and perfectly square across the top so that when the scriber is fastened on its lower edge will be the proper hight. The scriber should be hardened, ground and lapped on the lower side. Then to sharpen it will only be necessary to stone across the beveled edge at *A*, which will not alter the hight of the line scribed.

Albany, N. Y. T. Covey.







A HANDY HIGHT GAGE FOR THE MILLER

A Hand Operated Embossing Die

The following explains how the job, shown in Fig. 1, which we found to give considerable trouble when trying to do it in a press with a punch and die, was done by using the hand fixture, shown in Fig. 2 with an output of from 15 to 20 per minute:

The work is held tightly by the cam *A* and movable jaw *B* against the solid part *C*, the punch being actuated by the hand lever *D* through gear *E*, segment *F* and toggle joint *G*, a very powerful combination. The only thing necessary to do when changing a broken punch is to take out the screws *H* and *K*. The toggle at the joint *H* is backed up by the part of the bed *L*, which makes it very solid. The work is ejected by the pin *M*, which is thrown forward by the stop pin *P*, the spring *N* forcing the jaws apart. The hight of the embossing is regulated by the adjusting screw *R*. The fixture is held down to the bench by four screws.

Rochester, N. Y. Charles Eisler.

FIG. 1

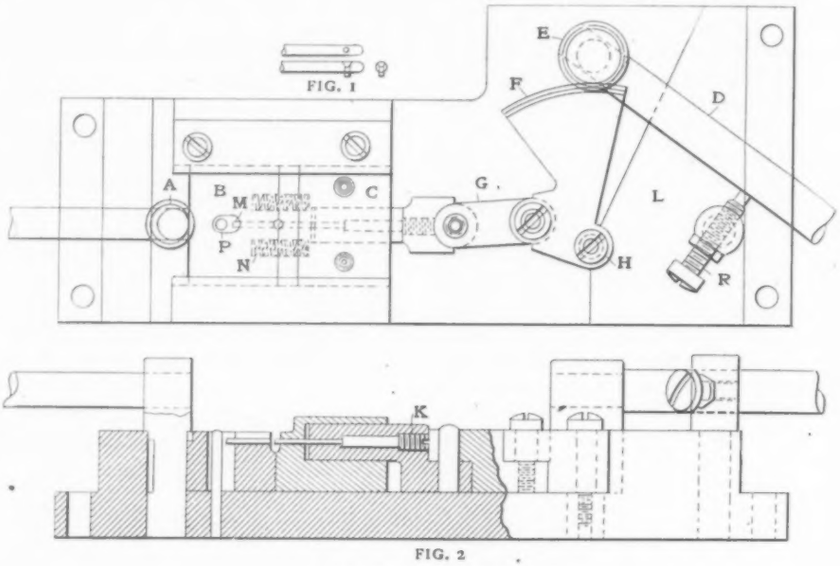
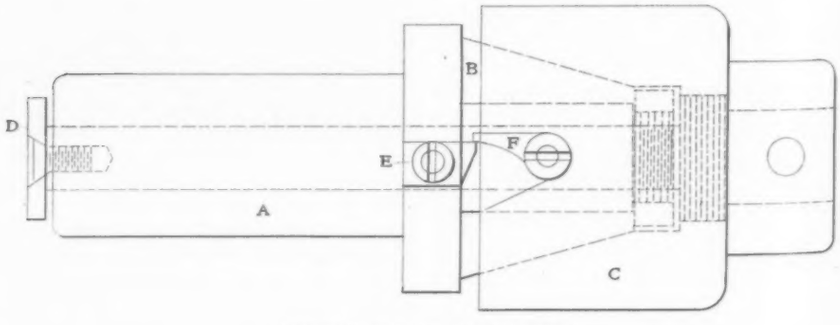


FIG. 2

A HAND EMBOSSING DIE

Friction Die or Tap Holder

The sketch shows a die or tap holder for screw-machine work. As the drive is by friction it does away with breakage of taps and dies. Referring to the sketch, the three main parts are the body or stem *A*, which fits in the turret; the cone *B* which is made of leather and of a suitable taper for driving; the holder *C* which is bored out to fit the leather cone. The front end of *C* is bored out to hold either a die or bush for holding taps.



FRICTION DIE OR TAP HOLDER

The tool should be made of cast steel throughout, the stem *A* being turned to fit the hole in the turret, and the other end turned down and a flange left for the leather cone *B* to bear against. Pins should be driven in this flange to act as drivers so that the cone *B* will not slip. The cone is clamped by a nut at the front end of the stem. A hole is drilled clear through the shank for the stem which is screwed in the holder *C*. A hole is tapped in the rear end of the stem and a distance piece or stop formed by the washer *D* which is secured with a countersunk head screw. A groove is milled in the flange on *A* for the catch *E*, which reverses the holder when the machine is reversed by engaging the pawl *F*, which is held in position by a small spring not shown in the sketch. There is enough space left between the washer *D* and the end of the holder so that it will free itself when the slide comes up against the stop in the usual way. The advantage of this holder is that the drive is regulated by pressure while the hole is being tapped; if the work seems a bit too much for the tap it can be easily detected by the operator by the pressure he applies to the handle.

London, Eng. CHAS. PETITJEAN.

A Punch for Punching Side Holes, and Folding Tools

Fig. 1 shows a telephone-transmitter back shell and the press tools for punching the small holes in the side and the hole in the top. The shell is shown both before and after punching.

Referring to the letters, *A* is the punch holder for the punch *B*. It also carries four cams *C* that transmit motion to the side punches, shown at *G*. Two rollers *F* are arranged to be acted upon by each cam *C*. At *E* is indicated a punch holder for one of the side punches. This is in the form of a slide, and in addition to holding the punch it carries the rollers *F*. The die holder is represented by the letter *D*. A blank in position to be punched is indicated by *H*.

The lever *L* forms the stripper. This is adjusted by hand after the blank is placed over the die, the swinging piece *M* rests upon the bed of the press and *L* strips the punched blank when the punch withdraws.

The parts *K*, *I* and *J* are for the knockout which is attached to the press in the usual way. This press tool is used in an ordinary punch press and is adaptable to any kind of shell.

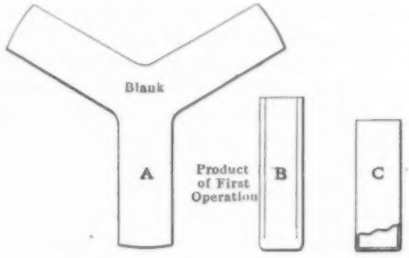


FIG. 2. BLANK AND FOLDED TUBE

FOLDING TOOLS

Fig. 2 shows at *C* a finished tube such as is used by the 100,000 by telephone companies. When made by drawing methods some six or eight operations are required. At *A* is shown a blank from which such tubes are folded; *B* shows an intermediate stage, or the product of the first folding operation.

Fig. 3 shows the tools for blanking and drawing. The operations are so simple that little explanation is required.

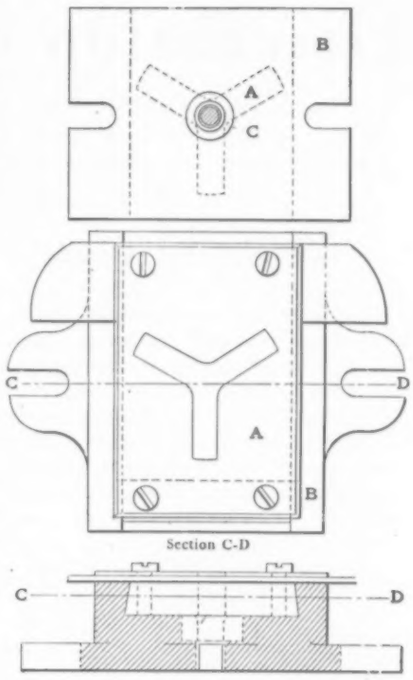


FIG. 3. BLANKING AND FOLDING TOOL FOR TUBE

Antwerp, Belgium. E. SCHWARTZ.

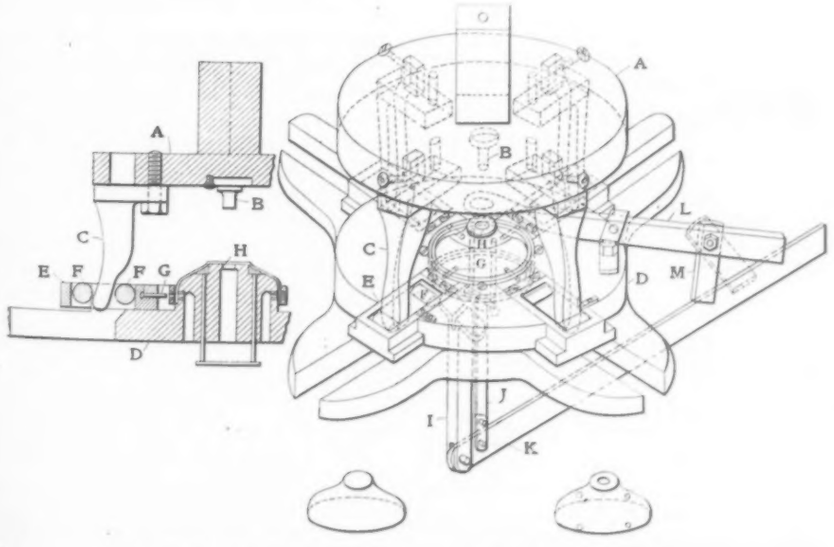
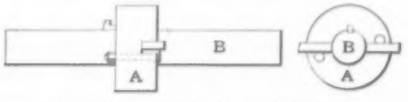


FIG. 1. A PUNCH FOR PUNCHING SIDE HOLES IN SHELLS

Holding Cutters in a Boring Bar

Here is a simple and effective method for holding cutters in a boring-bar head. In the construction of this bar and head, the *A* head is a cast-iron piece keyed to the steel bar *B*. After the head was bored and turned the bolt holes were drilled laterally 1/32 inch larger than the bolts, to give them side play. We reamed the taper about 3 inches to the foot with a flat drill ground on the sides. Then the slots were cut 1/32 inch wider than the steel for the cutters. This was done on a shaper. They were cut so that the leading or cutting face of the cutters was tangent to the shank of the bolts. The taper heads were turned on the bolts and one side was ground flat to bear against the cutter which it holds. This bar was used on a lot of air cylinders that were required to be duplicates. We made three sets of cutters to butt against the bar so no calipering was required. When the cutters became short from regrinding we stuck shims of paper on the ends touching the bar with shellac, which served until the job was finished.



HOLDING CUTTERS IN A BORING BAR

Indianapolis, Ind. CHARLES G. DEAN.

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

Continuous Nut Tapping

Having seen the new tapping machine in this week's issue of your paper reminds me of a simple tapping fixture we made a year ago for tapping out rough nuts. The quantities we use did not warrant the cost of an automatic machine. With the fixture designed as per sketch we were able to tap nuts very cheaply with a boy operator.

CONTINUOUS NUT TAPPING

The fixture consists of a casting cast in halves in order to be able to place the tap in position, finished at *a* and *b* and bored out to receive the hub of the pulley at *c*. It is held together by screws and dowels.

The pulley has a groove turned in the hub for a tit on the retaining screw and a square hole through the hub. The tap is an ordinary tap, as per sketch, and is bent at *e*. It is only necessary to start a few nuts on by hand to keep the tap central, after which a boy can keep the fixture in operation, the nuts falling out at *g*.

New York. D. F. KALISH.

Work Receivers for the Automatic Screw Machine

At page 667, Vol. 31, part 2, appears a description of "An Interesting Automatic Screw Machine Job," in which Mr. Carrel, however, omits to mention one important point, that is, the work when parted from the bar, did not fall, as the work of the screw machine usually does, among the chips, but was held, or caught in a receiver, and was carried around by it until, on arriving at the front of the machine it was deposited in a tray so that visitors could take one, or not, as they felt inclined. Is seems to me that almost all the screw-machine product might be handled in the same way. That is, it could be prevented from mingling with the chips, and so the necessity of riddling, separating, etc., would be avoided as well as in some cases preventing the marring or bruising of the product.

Herewith are sketches of some simple forms of work receivers, which are fitted to a spare hole in the turret, and receive the work as it is parted, and deposit it in a chute which leads to a tray.

Fig. 1 is designed to receive work such as screw pins, etc., the tail of the work entering the hole *a*, from which, at the proper time and place, it is ejected by the plunger *b*, which is actuated by the pin *c*, engaging with a suitable cam plate fixed in some convenient position. Fig. 2 is designed to receive work which has a central hole; in the shank will be seen a spring which returns the central pin *d*, after the work has been dropped in the chute. Fig. 3 is designed for the reception of larger work, and its main part is of gray iron. This is fitted with an ejector of somewhat different form, but its action is exactly the same as Fig. 1.

When all the holes of the turret are occupied, receivers can be designed in other ways, as part of the existing tools, or in some cases the tools may be combined and so make room in the turret.

A further advantage of receivers is that they can be arranged to deposit the work at a point where the operator can inspect it with the least trouble to himself, so insuring better inspection, and, of course, better product.

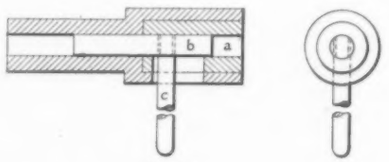


FIG. 1

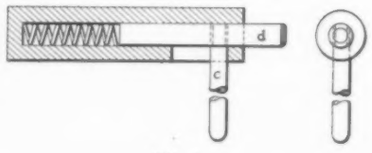


FIG. 2

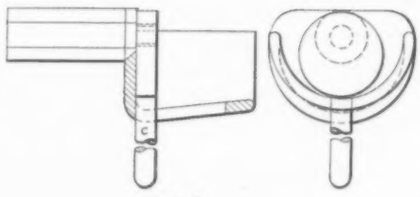


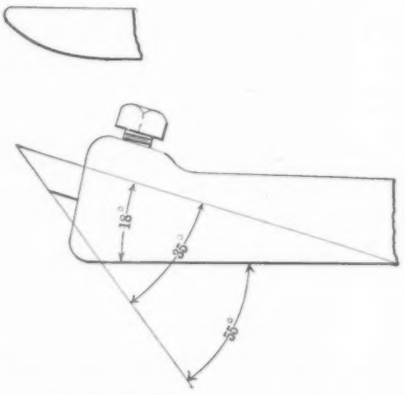
FIG. 3

WORK RECEIVERS FOR THE AUTOMATIC SCREW MACHINE

Manchester, England. JOE BROWN.

Grinding Copper

There has been a good deal written on the subject recently, but the quality or degree of finish obtained is vague. The copper rolls used for textile printing are ground, but not with an emery wheel, as far as I know.



TOOL FOR TURNING COPPER ROLLS

The rolls vary in size, of course, but take an average are say, 8 inches diameter by 30 to 36 inches long. These are bored and reamed to fit a steel mandrel which, as a rule, stays in them. They are then turned with a tool about like the illustration. I say about, because every turner uses the shape he likes best. The roll is turned dry, no lubricant being used, as a rule.

After turning, the rolls are burnished with a steel roller which is finished to a high polish, and has the edges rounded off. This burnisher rolls the tool marks down and puts a fair finish on the copper roll besides compressing the metal. The copper roll is then ground by hand with a block of gritstone (a species of sandstone) with water. After it is finished sufficiently with gritstone, it is thoroughly washed to remove all grit and is finished with Water of Ayr stone, used in the same way by hand, and a plentiful supply of water. This Water-of-Ayr stone has a fine grit, is dark gray with darker mottlings. It is found in the Water of Ayr, a stream which runs through the town of Ayr, in Scotland.

The finish obtained by this means is comparable to the finish on a copper card plate, or a piece of plate glass.

New York. E. A. DIXIE.

Lead and Pitch

On page 713, E. T. Strong writes that he has found exceptional difficulty in locating clear definitions of *lead* and *pitch*, as applied to screw and worm threads. He asks the AMERICAN MACHINIST to settle the question, and the editorial note which follows is evidently intended to comply with the request. Instead of clearing the atmosphere, however, more fog is added, which under the circumstances is to be regretted. Here, *lead* is defined as meaning "the advance between two complete turns of each thread of a screw." Such a definition can and would be translated in several different ways, and with the possible exception of a double-threaded screw it is incorrect for single or multiple thread.

A number of definitions can be given, any of which would clearly and properly define *lead*. From the machinist's point of view it could be best expressed thus: In a single- or multiple-thread screw, the *lead* is the distance the tool carriage advances for one revolution of the work.

Again: The *lead* is the distance, measured parallel to the axis, from any point of a thread to the next corresponding point of the same thread.

Or: The *lead* is the distance the screw or nut will advance for one revolution.

The *pitch*, as the note says, "is the distance between adjacent threads," no matter whether it is single or multiple thread. It equals one, divided by number of threads per inch.

The *lead*, on the other hand, changes with the character of the thread: For single thread it is equal to the pitch; for double thread it equals twice the pitch, etc. See the accompanying illustration.

It is surprising that anyone in these times of free public education should find any chance for argument over the definition of *lead* and *pitch*, and especially that mechanics should confound the words as to the same meaning. The one point that induces me to take up the subject is the fact that E. T. Strong, in his statement in the AMERICAN MACHINIST on page 713 says he has some difficulty to prove their true meaning by good authority.

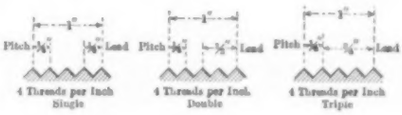
It is hardly necessary for me to mention the plain and definite explanations that the AMERICAN MACHINIST has brought out at different times, for they are as well known as they are adequate; but as back numbers are not always easy to get I will point out another source of information.

First, I wish to refer to Webster's Unabridged Dictionary where *lead* is defined as "to guide" or "conduct by showing the way," etc., then again "to introduce by going first," also "to draw." This seems quite sufficient when applied to a screw thread—a worm in mechanics is practically a screw thread engaging a worm gear or mechanism instead of the nut or internal threaded member—that the amount of *lead* will be the distance the engaging member is "drawn" or "conducted" by one complete revolution of the threaded member or worm.

Referring again to the same authority we find that *pitch*, when used in the sense under discussion, means "degree" which is the same as "a step" or "a distinct portion of space." Hence the step or distance from one thread or point to the next succeeding thread or point without regard as to whether the thread is single or multiple; it is now self-evident that with 10 threads per inch single-threaded the *pitch* will be 1/10 of one inch, and the *lead*, or the distance the engaging nut will be led by one full turn, will be 1/10 of one inch; but if double-threaded the pitch is still 1/10 while the nut will be led 2/10 or 1/5 of one inch.

George B. Grant in his treatise on gearing says that "circular *pitch* is the distance from a definite point on one tooth to the corresponding point on the next succeeding tooth, said points to be on the pitch line . . . . where only rolling contact takes place." But I never heard the term *lead* applied to gears.

According to Kent's Pocket Book the



LEAD AND PITCH

rule given by Mr. Sellers for threads is: "The *pitch* divided by 8, or one side of the thread divided by 8 equals the same thing, etc.;" clearly indicating that the *pitch* includes only one thread. Kent also gives the pitch of a propeller "as analogous to the pitch of a single-threaded screw."

Prominent manufacturers of small tools list screw-pitch gages, but they cannot measure the *lead*. Almost an endless amount of proof of the dissimilarity of the terms may be had by searching reliable works. The term *pitch* is also applied to the distance between rivets as in boiler work; but *lead* never.

New Britain, Conn. EUGENE PIERCE.

[Our understanding of the use of these terms is the same as that of our contributor, and we so intended to define them in our foot note on page 713. As our language was not clear to him it is obvious faulty, and our readers may accept his definitions as having our approval. —ED.]

Flattening Punched Blanks

In reply to the article in the European edition of the AMERICAN MACHINIST, "How Do You Flatten Punched Blanks," I may mention that we do a lot of this kind of work by simply giving the blanks a slight blow under a drop hammer, which is operated by a man, lifting the hammer by a foot lever, thus straightening about 1000 to 1500 pieces an hour.

OSKAR MULLER.

Mühlheim, Germany.

Making Automatic Screw Machine Cams

I have read with interest the articles by Thomas A. Dicks and W. McKenzie, at pages 719 and 972, Vol. 31, Part 2, on making cams for the Brown & Sharpe automatic screw machines; the former using a band saw for roughing out and finishing with a file, while the latter saws them out on a milling machine and finishes on a Besly grinder.

I think Mr. Dick's method of roughing out very good, but am afraid he will find very few shops equipped with metal-cutting band saws. While Mr. McKenzie objects to the expense of drilling I think he has overlooked the fact that he has sawed approximately 27¼ inches to cover a required distance of 10¼ inches, besides changing the position many times in the milling-machine vise.

While the finishing may be done with a file or on a disk grinder where the cams are of simple design, I believe some difficulty would be experienced in finishing them in this way for a fine class of work, such as clock work, when it is sometimes necessary to use one or two swinging tools and the timing must be accurate. In either case it would be necessary to lay out the cam blank very carefully first.

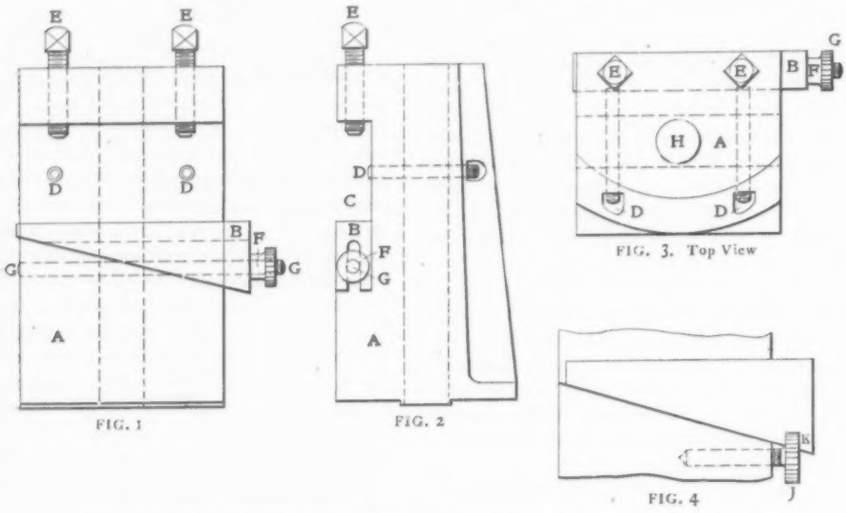
A plan that has been adopted where I am employed is to lay out the cams on paper with correct dimensions of each lobe in the required number of hundredths of the cam circle, then have it traced, after which two blueprints are made. The tracing is then filed away, as this firm believes in keeping a record of all tools. One blueprint is cut out to the outline with center and locating pin holes, and it is then an easy matter to place it on the cam blank with holes corresponding and stick fast with a little shellac or glue. An apprentice finds no difficulty in following the outline of the blueprint at a reasonable distance from the edge with a ¼-inch drill, after which the pieces are broken off. Then the work is taken to a Besly grinder where the sharp corners left by the drill are removed, after which it is sent to the milling machine with the remaining blueprint, mounted on a short arbor which fits the dividing head of the miller and finished with proper gears and angle of head and vertical attachment selected for the job, as described in the AMERICAN MACHINIST a number of times. In this way we have made many sets of difficult cams at comparatively small cost. Extreme care is not necessary in laying out, as in finishing we work to figures.

Albany, N. Y. A. C. RIDDER.

Round versus Square Tool Posts

The discussion on the above subject by J. H. Thompson, on page 368, and R. Samuels on page 717, has interested me somewhat, as the former praised up the square type of tool post for capstan-lathe cut-off slides, while the latter correspondent prefers the round type, and ventures to say that it has virtually swept the square type off the market, I beg to contradict that statement, that is, as regards turret-lathe cut-off slides. To substantiate what I say one has only got to examine the turret lathes made by some of the leading American and European firms. For instance, Brown & Sharpe, whose tools enjoy such an enviable reputation both in this country and abroad, fit a square tool post on some of their lathes similar to the one shown in Figs. 1 to 3. This tool post, it will be noticed, is not of the same construction as shown by J. H. Thompson, on page 368, and is free from the defects inseparable from that design. The one here shown is superior in every way to either of the tool posts shown by your correspondents, and possesses the advantages of them both; it is massive, with plenty of room for the wrench at the top when securing the cutting tool in position, without any fear of breaking the set-screw heads off, or lifting the top of the post up with a screw-jack action, as suggested by R. Samuels. Referring to the illustrations, *A* is a mild-steel post, and *B* the adjusting wedge to locate the cutting tool to correct hight; *C* is the space for holding the cutting tool. *D D* are two small adjusting screws for resting the tool against, so as to set it at any angle, an important feature not possessed by either of the two tool posts before described. *E E* are the two screws for securing the tool in position. *F* is a milled nut for setting the wedge *B* by operating on the threaded stud *G*, the wedge *B* being slotted to receive this stud, as shown at *I* in Fig. 1. *H* is the central hole for the bolt which fastens it to the cut-off slide.

Another form of the adjustment for the tool is shown at Fig. 4; the wedge has a notch milled in, as shown at *K*, into which the milled head of a thumb screw *J* fits, and thus draws it backward or forward whichever way it is turned.



ROUND VERSUS SQUARE TOOL POSTS FOR CAPSTAN LATHE CUT-OFF SLIDES

London, England. "CAPSTAN."

Straightening Punched Blanks

On page 753 George Wilson has submitted a cut of some samples from a blanking punch and die which he says are convex, and requesting someone to suggest some means by which he can straighten them.

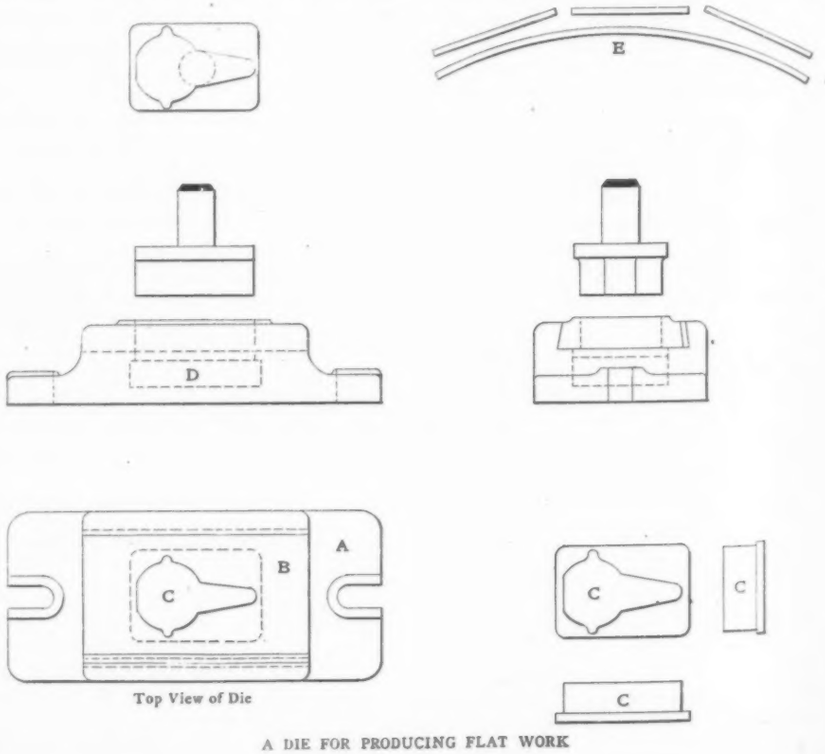
One very good way is to put them through another press operation, between what is known to the trade as "flatters." You put a perfectly flat die about 8 inches square securely held in your bolster plate and a flat punch of the same dimensions in the ram of the press; now adjust press so you will strike a good blow. You can straighten as many with one blow as the die block will accommodate, being careful not to put one on top of the other.

I quite agree with the editor that the fault is in the construction of the die. I submit the cut of a punch and die designed to overcome the necessity of a second operation and one from which the blanks will be perfectly straight.

The die block *B* has a steel pad on knockout *C* fitting the opening of the die block *B* to a good working or running fit; the shoulder on the pad *C* brings up against the bottom of die block *B* thereby bringing the top of the pad *C* flush with the top of the die block *B*; the pad *C* is held in position by means of a piece of rubber which is large enough to fill the opening *D* in the bolster plate *A*. This pad *C* will force the blanks back into the scrap and you will be able to use any convenient length of the strips, and when you have punched a strip you can bend it, as shown at *E*, and your blanks will snap out into a box for this purpose and be perfectly straight.

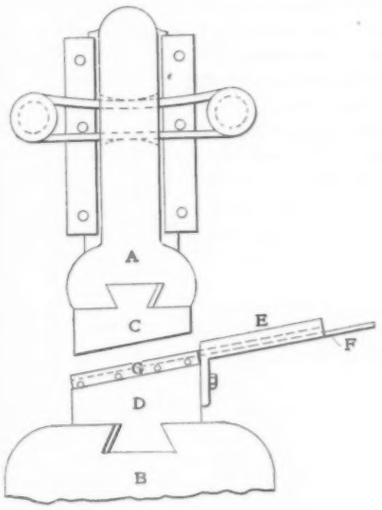
Utica, N. Y. P. E. W.

In regard to the inquiry of George Wilson how to straighten punchings, I send a sketch of a fixture that was made to overcome the same trouble that he speaks



A DIE FOR PRODUCING FLAT WORK

about. We rigged up the smallest power hammer in the forge shop in the manner shown. *A* and *B* are hte hammer and anvil of the power hammer. *C* is the upper die. *O* is the lower die. These dies were planed at an angle of about 10 degrees. A raceway *E* was bolted to the side of the die *D*, at the same angle as the die, to receive the punchings. This raceway had to have a cover on top to



STRAIGHTENING PUNCHED BLANKS

prevent the pieces from riding on top of each other. A small platform *F* was left extending out from the raceway as a means to feed. Two strips *G* on each side of the die *D* were to guard against the punchings running off sideways.

It required some experimenting to get the right angle on the dies so that the punchings would not be hammered more than necessary, about three blows being all that was required. The jar of the hammer caused the automatic feed and discharge aided by the angle of the dies. The hammer was run with light and rapid blows, and all that was necessary was for a boy to place the punchings on the platform *F* as fast as they were discharged.

Boston, Mass. TECHNICK.

The intrinsic brightness of nearly all artificial lights is much greater than that of daylight, which accounts for the injurious effects they produce on the eyes if located within the range of vision. From a discussion on the subject before the Illuminating Engineers Society it is noted that daylight commonly runs as low as one-tenth, or even one-hundredth of a candlepower to the square inch. Although it has been claimed that the injurious effects of artificial light were due to the ultra-violet contained therein, it was here pointed out that there is less ultra-violet light in the rays of various incandescent illuminants than there is in direct or reflected sunlight, so that the injurious effects of the artificial means are traced to the greater intrinsic brightness.

The Automobile Show in Madison Square Garden, New York

EDITORIAL CORRESPONDENCE

The automobile is considered by many the one thing of the present time that has absorbed the time, skill and ingenuity of the engineer, designer, inventor and mechanic in turning out a product that is as nearly perfect as it is possible to make it.

Practically no expense has been spared in making the automobile a machine that is under the absolute control of the driver on all kinds of roads and under all the conditions liable to be met with. The strength, stability and long wearing properties of the materials used have also been well looked after so that the motor car of today will stand all kinds of hard usage and be perfectly safe and comfortable to ride in.

The materials used in constructing an automobile, and those needed in the articles to equip it with, are of so many different kinds that the industries called on to furnish these materials are numerous.

THE EXHIBITION AND EXHIBITORS

The automobile exhibition that has just closed at Madison Square Garden in New York illustrates very conclusively by the exhibits of materials, supplies and accessories, as well as by the exhibits of the finished motor cars, the truths of the above statements. This year's show was noted, among other things, for the entire absence of any freak ideas, either in the power plants of the numerous cars shown, or the shapes, styles and colors of the bodies and running gear, which go to make up the general appearance of the cars.

The accessories part of the exhibition was the largest that has been given in any of the numerous shows that have been held in the past. The number of exhibitors was the largest and numbered over three times that of the exhibitors of the complete cars. The variety of things exhibited was also larger than at any previous shows and included everything from the machines with which to build automobiles, the metals, castings and materials, to the bodies, lamps, wheels and tires with which to equip them, as well as to the furs, clothing, goggles, etc., with which to supply the drivers and passengers. This included such things as machine tools, hand tools, steel forgings, castings of iron, steel, brass, bronze, aluminum and numerous other special alloys of the white and yellow metals such as are used for bearings or parts which do not need any great strength, magnetos, spark plugs, coils, batteries, tires, wheels, bodies, horns, lamps, generators for lighting gas, springs, shock absorbers, frames, hoods, glass fronts, leather for trimmings and many other things.

THE MOTOR CARS

The automobiles that were exhibited were limited to those that are made under a license from the Association of Licensed Automobile Manufacturers, commonly called the A. L. A. M., and consequently there were not as many exhibitors of finished cars as at the Grand Central Palace show. The cars shown, therefore, were all of American make.

The pleasure cars shown numbered one hundred and seventeen and they were exhibited by thirty different makers. The runabouts, which are sometimes called tourabouts, speed cars, etc., ranged in price from $1250 to $5500, unless one could place the Waltham buckboard in this class, which sells for $350. The touring cars ranged in price from $1250 to $6000, while the inclosed cars like the limousine, landaulet, cabriolet, etc., could be had for from $2500 to $7300.

The electric cars were shown in a room by themselves, to the right of the main entrance and varied in price as much as the gasolene cars. Some of these were very luxurious in their upholstering and trimmings and even ran to the point of gaudiness in their colors.

The trucks were shown in quite a variety of sizes and one was on the street as a part of the show that had a carrying capacity of ten tons. This is the first successful truck of this size that has been built and it was only made possible by making the tires out of blocks of rubber with a space between each block, the tires being the principal drawback toward building large trucks.

The motor cycle exhibit was one of the largest that has been given and included nearly all of the makers of this style of conveyance.

THE MOTIVE POWER

The gasolene engines were nearly all of the four-cycle four-cylinder, cast in pairs, water-cooled type, and this is fast being made the standard for motor cars. There were, however, a few notable exceptions to this rule, among them being the Cadillac, Elmore and Franklin cars.

The Cadillac has for several years been building a single-cylinder car that has given good satisfaction wherever used. In fact, they have made a success out of the single-cylinder engine when many others have made the attempt and failed. The car they showed this year sells for $950, with a touring body to seat four persons, and at $850 with a runabout body that seats three. This same company exhibited a new car this year that attracted a great deal of attention. It is fitted with a tonneau body that seats five persons and sells for $1400. The engine is a four-cycle, four-cylinder, water-cooled one of 30 horsepower. It is jump spark, with batteries or magneto, and shaft driven with three speeds forward and one reverse.

(Continued on page 159)

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

JOHN A. HILL, Pres. and Treas. ROBERT MCKEAN, Sec'y.

505 Pearl Street, New York.

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Hill Publishing Co., Ltd., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Business Telegraph Code.

CIRCULATION STATEMENT

During 1908 *we printed and circulated* 1,205,750 *copies of the* AMERICAN MACHINIST.

Our circulation for December, 1908, *was (weekly, monthly and European)* 108,250.

January 7	34,750
January 14	19,500
January 21	19,500
January 28	19,500

This paper reaches 34,750 *separate readers each month and* 19,500 *each week.*

None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

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Industrial Education in New Jersey

We are in receipt of the report of the commission on industrial education which has recently been submitted to the legislature of the State of New Jersey, this report being the outgrowth of the resolution passed by the legislature April 14 last, by which the commission was authorized.

The commission began its work by sending out a large number of letters to employers and employees throughout the State, the result being a list of over 2000 replies from firms engaged in productive industries in the State employing upward of 250,000 employees. These replies indicate an almost unanimous demand for industrial schools of some kind, although the consensus of opinion is against trade schools, meaning by that term those in which shop work predominates, the objection being based upon the belief that such schools would be too expensive and that even if provided at great expense they would reach but a comparatively small percentage of the population. There is also a well defined opposition to the partial-time school, the belief being that this system would disorganize the factories and shops. This latter objection is no more than natural on the part of manufacturers, and we are, therefore, surprised that the commission does not point out the experience with the half-time idea in Cincinnati, which completely disarms this criticism. We believe that this half-time school idea is to be one of the large factors in the solution of the industrial education problem and with the unquestioned success of the Cincinnati experiment there can be no doubt that the objections to which we have referred are unfounded.

The report points out that New Jersey was the first State of the Union to make effective provision for a system of State-supported industrial schools, which it did through a law passed in 1881, and from which has developed the Newark Technical School, the Trenton School of Industrial Art, and the Industrial School of Hoboken. The report points to the large development of industrial schools in European countries, and it also gives in brief words the action already taken by various States of the Union, from which we discover that legislative action has been taken by Massachusetts, New York, Wisconsin, Connecticut, Georgia, Alabama and Oklahoma. In Massachusetts over 2500 pupils are already enrolled in the new schools, while Georgia has 11 district agricultural schools, and Alabama 9 similar institutions. The report recognizes that, "A great difficulty in the organization of industrial schools of elementary grade at present is the lack of vocational textbooks, both special and elementary in character, as well as the lack of instructors qualified to undertake the very practical teaching that is required." The report concludes with the draft of an act providing for the establishment of schools for industrial education in the State of New Jersey.

Unproductive Time

When one carefully studies the output from almost any class of tools, and notes the discrepancy between the time per piece and the number of pieces per day, he is impressed with the loss in production between the theoretical maximum and the practical average as it comes to him in the cold, hard facts of the time card, or the production list. The first assumption is too often that the man has not been doing his full duty. The output seems to point this out clearly, but the practical shop manager knows better than to attribute it all to that cause.

The unproductive time, the time when work is being handled, the tools set up and adjusted in the case of automatic machinery, the grinding of tools, or the other reasons why a machine is not being run continuously, is the real reason for the failure to attain the maximum.

If all the items that go to make up the work, including handling and setting up, are carefully considered, it will often be found that the unproductive time is fully as much as the actual time of production. This not only means an increase of the labor cost, but a loss of product from a machine, which, perhaps, represents a heavy investment of capital. Every moment this is idle adds to the overhead changes of the plant and increases the cost of production over the theoretical maximum.

This shows us why it will often be found that a greater saving can be made by attacking the unproductive parts of the operations rather than by devising new tools or speeding up machines. Bearing in mind that the more minutes out of an hour a machine is actually at work, the lower the cost of the product, it pays to watch the chucking fixtures as well as the man who handles them and reduce the idle time of the machine as much as possible. It is very much like reducing the station stops of a train instead of increasing speed to maintain the schedule; or with both looked after to decrease the time taken for the run.

This is one of the drawbacks to having learners of any kind, whether handy men, specialists, or regular apprentices; they tie up expensive tools while learning to set up, as clamping work to a planer bed, camming a screw machine, or similar preliminary operations. Still men and boys must be taught and the same attention to fixtures which will shorten the time for the regular workman will also help in this case.

We are so apt to let our thoughts and

efforts run in one channel, such as high cutting speeds, that we overlook other points equally important, and it is to call attention to another phase of the question of production that this is written.

Charles Howard Besly

Charles Howard Besly died on Thursday, December 31, at the Henrotin Memorial Hospital, Chicago, as the result of an operation. The funeral was held at his residence, 399 Ontario street, Chicago, January 2. According to his wishes his body was cremated at Graceland.

Mr. Besly was born in Milwaukee, June 16, 1852, and had been a resident of Chicago since 1863. He was a graduate in chemistry of the Rush Medical College, of Chicago, and he also spent a year in a mechanical school of London, England.

CHARLES HOWARD BESLY

He began his business career with Marshall Field & Co., and later was employed by S. D. Kimbark & Co. and by Crerar, Adams & Co. In 1873 he became manager of the Bergen Tool Company, of Batavia, Ill., and traveled extensively. He was also at an early date a broker of machine supplies and opened a small store on Lake street in 1875. In 1881 he, with David J. Kennedy, established the firm of Charles H. Besly & Co., from which Mr. Kennedy retired in 1886, since which date the business has been conducted by Mr. Besly under the old firm name. In 1891 the business was moved to 10-12 North Canal street, and in 1903 to its present quarters at 15-21 South Clinton street. In 1886 Mr. Besly established another business under the name of the Brown & Besly Company, dealing in letter files, filing cabinets, etc.

In addition to his business interests Mr. Besly was much interested in farming, and at Edison Park, Ill., he was a breeder of Guernsey cattle. He was a member of the American and Western and Illinois Guernsey Cattle Club, the National Horticulture Society, the American Geographical Society, the Engineers' Club, and the Machinery Club, of New York, and of the Chicago Athletic Association. the Union League Club, and the Chicago Yacht Club, of Chicago.

Mr. Besly's strong personality and his more than ordinarily jovial disposition gave him a wide circle of friends, and he was always a center of any gathering of men. He was twice married, first to Minnie Wells, and second to Kathleen Healy, who, with four daughters, survives him.

New Publications

MECHANICAL ENGINEERING AND MACHINE SHOP PRACTICE. By Stanley H. Moore. 502 6x9-inch pages with 375 illustrations, including diagrams, charts and tables. Hill Publishing Company, New York City. Price $4 net.

This book is intended as a general text book and reference work on modern shop practice and correlative mechanical engineering, and while written primarily for students and apprentices, should be a useful reference book for both the machinist and the technical man. Of the 20 chapters in the book, 12 chapters, or more than 300 pages, pertain to shop practice under the following heads: Cutting Tools; Measuring and Small Tools; Screw and Pin Data; Bench and Vise Work; Turning; Boring; Drilling; Grinding; Planing; Milling; Miscellaneous Machine Tools and Accessories; Shop Processes and Kinks. These chapters, as is suggested by their titles, contain much information on forms and applications of cutting tools, their speeds, feeds, etc., types and uses of various classes of gages; tabulated data relating to screws, bolts and nuts and various forms of threads; gearing; allowances for different kinds of fits; descriptions of machine tools and methods of handling them, and much other helpful matter. Other chapters deal with Materials; Friction, Lubricants and Lubrication; Mechanics; Power Generating Machines; Elementary Electricity; Power Transmission; Motor Drives and Motor Driven Machine Tools. These subjects are treated in a manner that should make them of interest to the shop man as well as to the technical student, and the system followed throughout the book, of numbering the illustrations to correspond with the paragraphs, makes the volume a very handy one for reference purposes. In this connection it should be stated that the table of contents is so arranged that the reader is enabled by glancing at the number after a subject, to tell at once the chapter, classification and section of the book where the information is to be found. In addition to this convenient table of contents a very complete alphabetical index is included at the rear of the book.

NOTES ON PRACTICAL MECHANICAL DRAWING. By Victor T. Wilson and Carlos L. McMaster. 160 6x9-inch pages, with 66 illustrations in the text. Wilson & McMaster, East Lansing, Mich. Price, $1.50.

This book is a compilation of lecture notes prepared to meet the needs of students in engineering courses. The noticeable feature of its method of treatment is the substituting of practical problems for the usual line exercises and geometrical drawings. This feature is worthy of commendation, for it is undoubtedly easier to arouse and hold a student's interest in practical points of engineering work than in meaningless geometrical figures. Another valuable feature is the treatment of machine sketching. Many machine details are worked up from rough pencil sketches, and a successful draftsman and designer should be able to sketch rapidly and accurately both in perspective and orthographic projection. This same facility in free-hand sketching is of value in making rough working drawings, and temporary drawings to be later developed into permanent records. The question of drawing-room conventions is touched upon, but not to an extent that the subject seems to warrant. Drawing-room practice in the United States is well crystallized today, and there is no good reason why it should not be taught to engineering students as a part of their regular mechanical-drawing course. The authors' preface states that the work is not complete, and this may account for our failure to find a treatment of cams and gearing, two important elements of machine construction whose treatment has a logical place in any course of mechanical drawing. The text is clearly written, the illustrations are well made, and the work should prove of real value in its field.

Vaudeville at the Machinery Club

A novel entertainment in the form of a vaudeville smoker was given by the Machinery Club at its club rooms Saturday afternoon, Jan. 16. The star feature of the afternoon was a lecture with lantern slides by Homer Davenport, the cartoonist, giving details of a trip among the Bedouins of Arabia. The club quarters were crowded, about 2000 members and guests being present, among them being a large number of the shining lights of the machinery trade, many of whom were from out of town. The success of the occasion will doubtless lead to its becoming a feature of the club life.

New Tools and Machine Shop Appliances

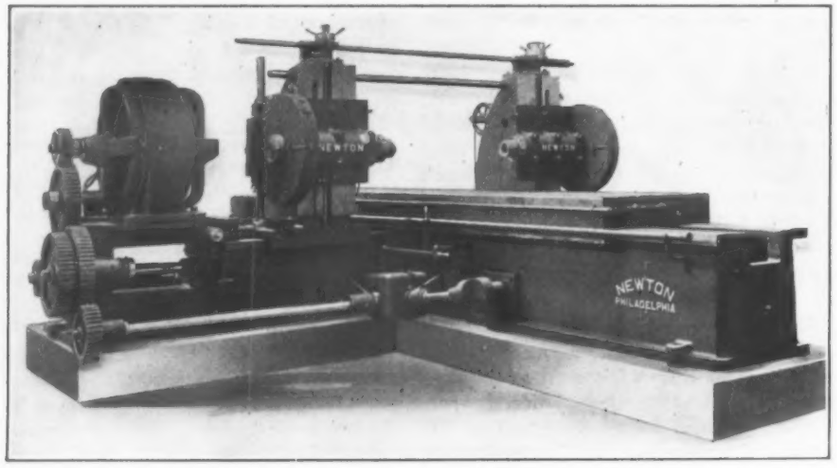
Showing New Ideas in Machine Shop Equipment That Make it Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

Large Duplex Milling Machine

The spindles of this machine are 6 inches in diameter, driven by a 33-inch bronze worm wheel with hardened-steel worms having thrust bearings. Spindle saddles are counterweighted, have vertical feeds, hand and rapid-power vertical adjustment from within 5 inches of top of work table to a maximum distance of 26½ inches, while the uprights have in-and-out hand adjustment from 30 to 60 inches between the ends of the spindles. The work table is 42 inches wide and 15 feet 6 inches long, will mill 14 feet in length, and is entirely surrounded by an oil pan fitted with lubrication system arranged to carry the lubricant to a storage tank in the rear of the machine and return to the cutters by a pump. The table is driven by steel rack and a bronze spiral gear through a speed box, by a 35-horsepower variable-speed motor. A double-throw Carlyle-Johnson friction clutch gives a reverse to the feed motion, which is further transmitted through the miter gears to the right-hand side of the machine. This is their standard type having one stationary and two sliding sleeves upon each of which are three gears, two of which are cut from the solid. The sliding sleeves are operated by the two latch-pin levers shown, giving nine combinations and feeds of from 0.789 to 8.15 inches per minute at the high and table feeds of from 0.394 to 4.08 inches per minute at the slow speed of the motor. The quick return to the table at the high speed of the motor is 22 feet per minute. All of the operations of this machine, with the exception of obtaining the different feed combinations, can be controlled from either side of the machine.

The wings, on which the uprights are mounted, are of very solid construction and have T-slots cut from the solid bearings which permit of clamping the uprights securely in position with four bolts. With this design the adjusting shoes can always remain adjusted for a running fit. Additional changes of speed to the spindle are obtained through change gears. This is made by the Newton Machine Tool Works, Philadelphia, Penn.



LARGE DUPLEX MILLING MACHINE

The Dallett Air Compressor

The illustration shows one of a new line of air compressors which have recently been designed by Thomas H. Dallett Company, Philadelphia, Penn., in both belt- and steam-driven types. The aim has been to combine extreme rigidity with convenience of operation, adjustment and repairs. It is also part of the plan, as

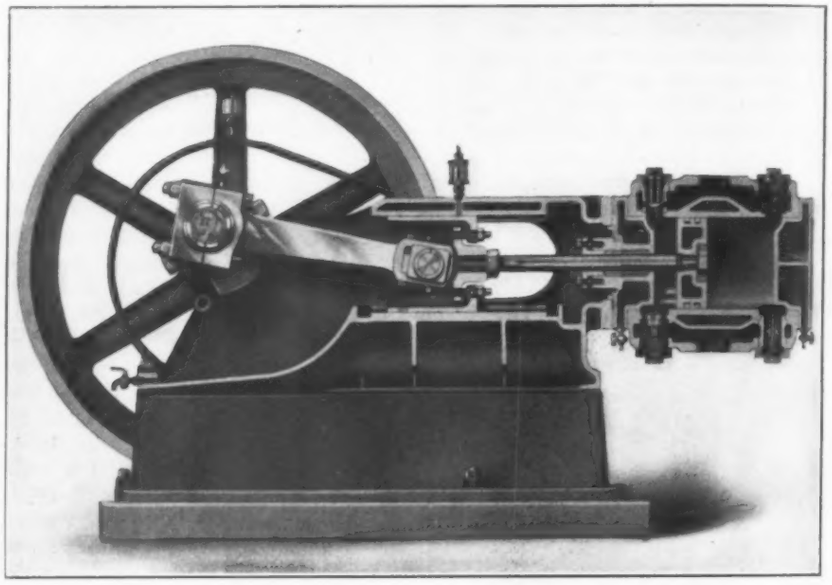


FIG. 1. THE DALLETT BELT-DRIVEN AIR COMPRESSOR

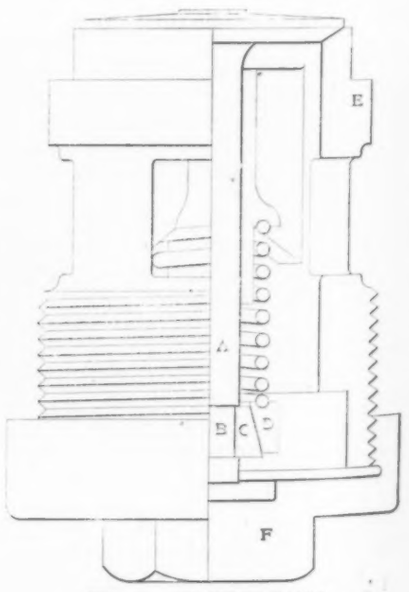


FIG. 2. AIR INLET VALVE

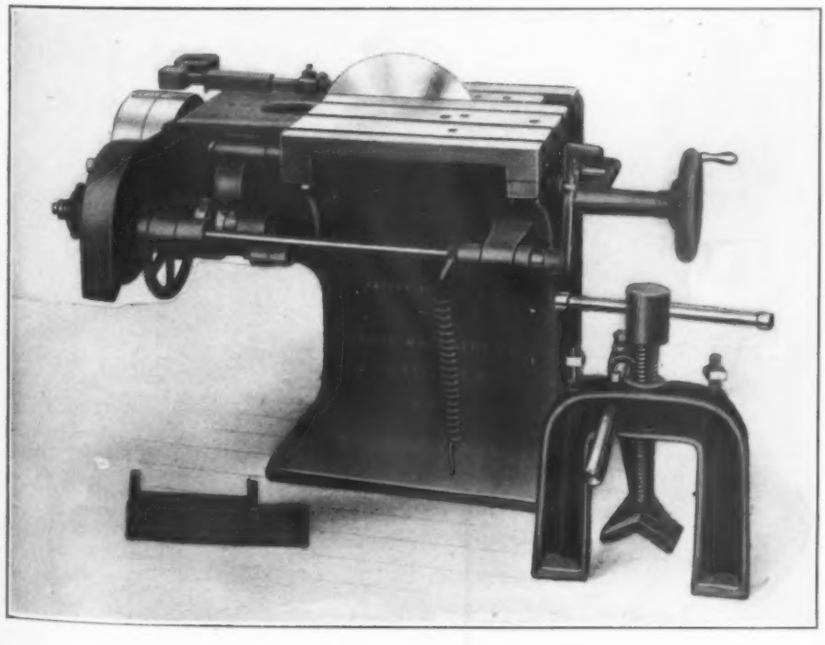
the demand for compressed air grows in any shop, to substitute the next larger sized cylinder so as to give a larger volume of air, at the same time maintaining the standard pressure of 100 pounds.

As an example of the attention to details, we show the intake valve, which can be removed from the cylinder, taken apart, examined, and replaced in a remarkably short space of time, as there are no threads except those holding the cage in the cylinder. The valve and its stem *A* are of special alloy steel, and it has a recess turned near the end of the stem at *B*. The cone washer or ring *C* is made in halves so as to be slipped into the recess *B*, and is held in place by being drawn down into the spring retainer *D*. This arrangement holds the spring and valve effectually, and at the same time allows its removal at will. The cage screws into the cylinder, and seats at *E*, cap *F* acting as a lock nut for holding the cage in place.

Both the belt- and steam-driven machines are provided with unloaders which, in the latter case, controls the speed, or even stopping the machine in the case of a duplex, while with the belt-driven machine it automatically holds open the intake valve until the pressure drops to the desired amount.

A New Cold Saw

The saw in this machine is driven from six points, holes in the saw fitting over three hardened pins and is held to the worm by three cap screws. The worm wheel is large to give good driving power. The saw is fed into the work by a carriage on which it is mounted and which carries a guide for the saw which also acts as a stripper for chips. The feed has an automatic knockout which can be set at any desired point. It is made in two sizes, carrying 12- and 20-inch saws, and with cutting capacities of 3x5 and 5½x12 inches, respectively. It is made by the Burke Machinery Co., Cleveland, Ohio.



A NEW COLD SAW

Perfection Wrench

The "Perfection Wrench," shown closed in Fig. 1 and open in Fig. 2, can be used as a vise, clamp, jack, tool holder, and pipe or bolt wrench. It is made entirely of steel and has many novel features in its construction. It has an instantaneous adjustment, a positive and powerful grip regardless of any irregularities in the object held, and has no "back lash" or lost motion. It can be used as a parallel drill-press clamp, owing to the plane between its jaws being perpendicular to the press platen, whether it is resting on its back or side.

By moving the lever *A* the inner jaw can be slid back and forth on the shank *C* and set to the right size by the graduations on it, thus giving a quick adjustment. By gripping the handle, which presses down the lever part of the handle *D*, the wrench will grip the piece tightly. The pressure of the grip can be increased or decreased by screwing in or out the screw which is moved by the nurled disk *E*, thus giving a fine adjustment. The wrench can be locked to the piece it is gripping by moving the lever *B* which operates a cam.

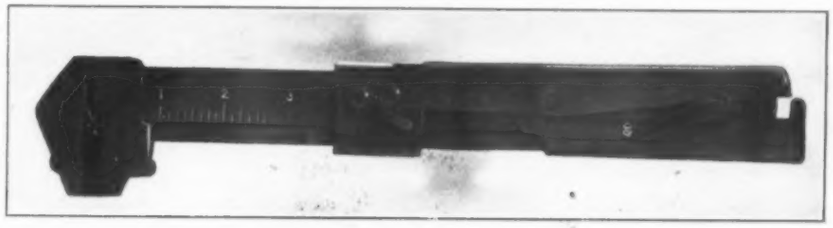


FIG. 1. PERFECTION WRENCH, CLOSED

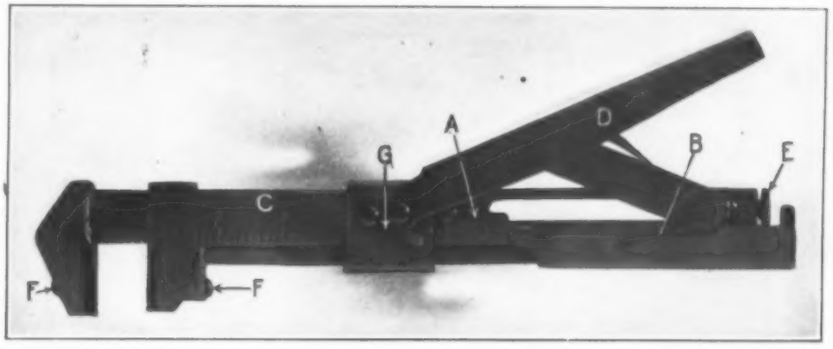


FIG. 2. PERFECTION WRENCH, OPEN

The jaws, which are shown with teeth for gripping pipe, can be removed by taking out the screws *F* and jaws inserted which have a smooth surface that will not injure plated nuts or jaws of any desired shape can be used, so that they will grip any kind of an irregular shaped piece.

By setting the levers *A* and *G* in the right positions the lever handle *D* can be moved in and out to gradually force the inner jaw up to its position and it can then be locked there. This makes it useful as a forcing jack and hand vise. This wrench is made by the Perfection Wrench Company, Port Chester, N. Y.

Bath Universal Grinder

The new design of this grinder, together with its many attachments, is shown in Fig. 1. While it retains the same general features as the former machine, a number of the details have been greatly improved, as can be seen from the other illustration.

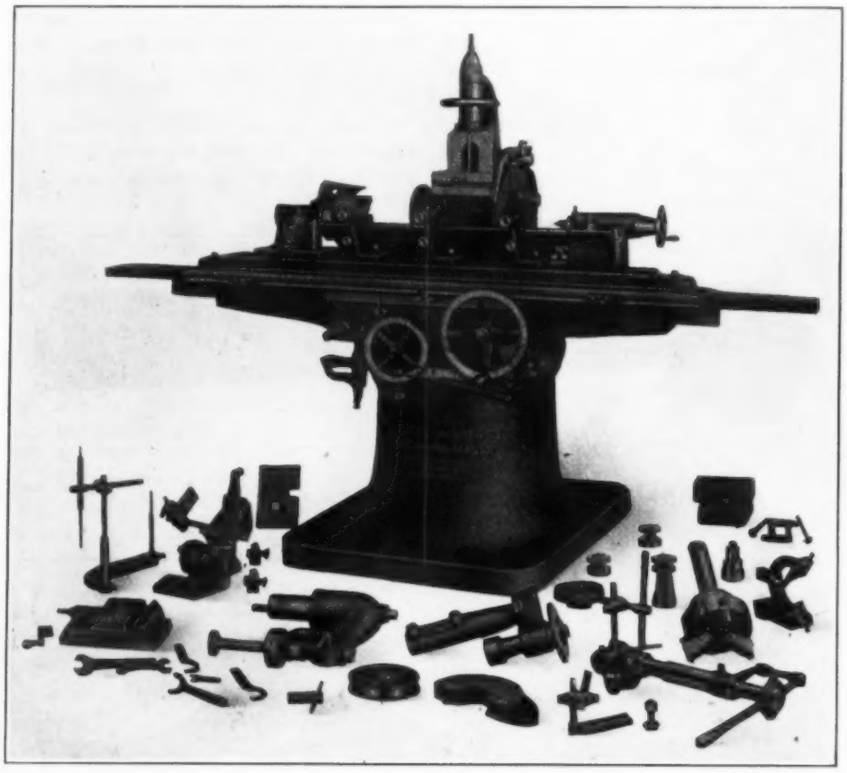


FIG. 1. BATH UNIVERSAL GRINDER

Fig. 2 shows the apron with the automatic cross-feeds, one being for cylindrical and the other for surface grinding. These are independent of each other in every way. Both are operated by trip lever *A*,

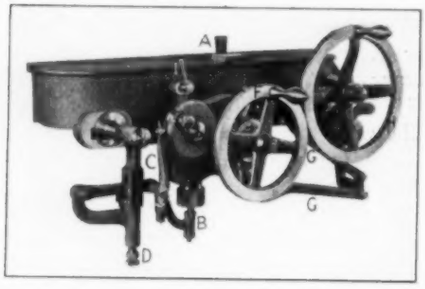


FIG. 2. APRON WITH CROSS-FEEDS

which when the fine feed is thrown in by the handle *I*, forces down the end of the lever *B* at the end of the stroke, pulls down the lever *C*, its travel being limited by the stop *D*, and in this way feeding as little as 0.0002 if desired. This ratchet wheel has micrometer divisions, and the riding throw-out shown, stops the feed at any desired point and secures the right diameter automatically. The regular cross-feed for surface work is secured by lever *G*, operating on the coarser ratchet inside of wheel *F*, while hand wheel *H* controls the movement of the carriage along the bed. The carriage feed is controlled by *E*, so that the operator can stop it instantly at any point, or by turning it, can have it stop automatically at the end of the stroke.

Fig. 3 may perhaps be called a universal head, consisting of a footstock with a swivel base, in which is a sleeve carrying a hand-operated spindle with a universally jointed head on the end. In this case the cutter arbor is turned at right angle to the spindle itself for grinding the sides of the milling cutter. This can be swung parallel with the spindle, or at any angle to it that may be desired, and can also be turned the other way to any degree.

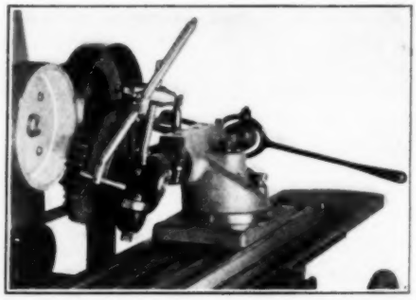


FIG. 3. UNIVERSAL HEAD

This also shows the tooth rests or stops, which swing out of the way for indexing, and which can be swung to any desired angle. On the other end of the tooth rest is the diamond for truing the wheels, and which can be swung around to any angle. It will be noticed that the supports for this are grooved at regular intervals, and this forms a very convenient feature.

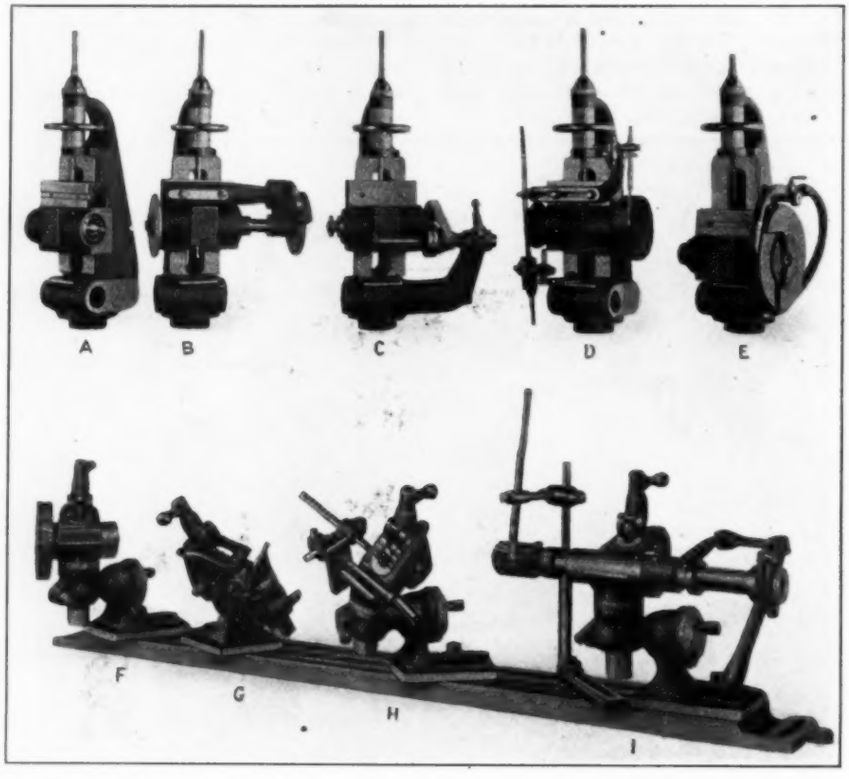


FIG. 4. ATTACHMENTS IN POSITION

which is used on all rests. A small spring-actuated plunger is inside the clamping post, so that unless the set screws are tightened hard the clamping post can be moved up or down, or swung in any position and will remain there without being held, which is a great convenience in setting up.

Fig. 4 shows a number of the attachments in place, *A* being a small auxiliary spindle for very fine work, *B* an extension support when it is desired to have a wheel away from the head, *C* the internal grinding attachment, *D* two supports for tooth rests which seem to accommodate all conceivable cases and E the wheel guard and with the Wizard nozzle in place. The next four show a universal head on the same order as the one in Fig. 3, but arranged with a cylindrical clamping device which will hold either straight or tapered shanks, as shown. These can be swung at any angle, while at *I* is shown the same spindle as in Fig. 3, except that it is held in the universal head and is used without the double swing attachment on the end.

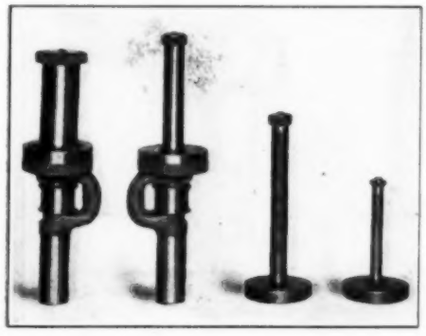


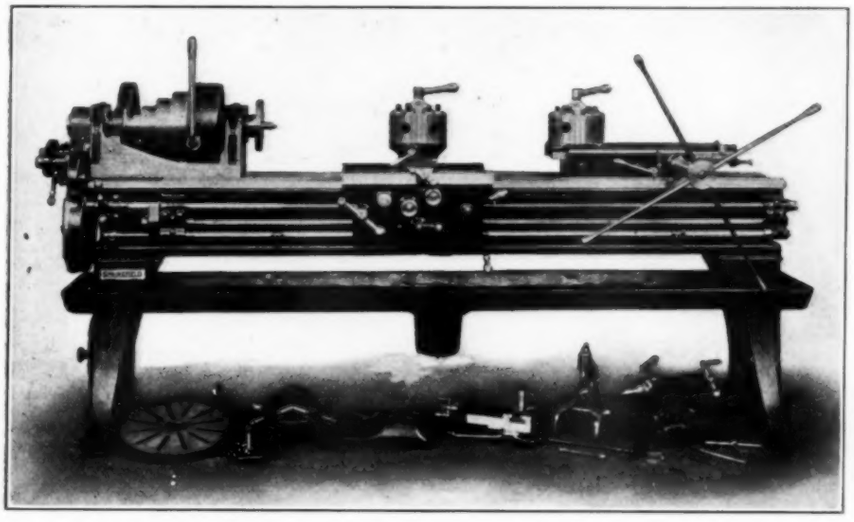
FIG. 5. INTERNAL GRINDING SPINDLES.

Fig. 5 shows the internal sliding spindles for various sized wheels, which are somewhat different from the usual construction. In this case these bushings fit a large flange, which is held tightly at the end of the grinding arbor, and it will also be noticed that the bronze support is as large as can be used with the wheel shown. These bronze bushings carry the spindle and support it at each end, insuring as much rigidity as is possible with a small spindle.

The use of the various attachments will be perfectly clear to any practical grinderman, and it seems as though every conceivable grinding operation had been provided for. This machine is built by the Bath Grinder Company, Fitchburg, Mass.

14-inch "Ideal" Engine Lathe

The accompanying illustration shows a 14-inch by 8-foot engine lathe with a number of attachments that accompany it. It is equipped with the "Ideal" rapid-change gears, has a friction head, automatic feed stop in either direction and reverse for both turning and screw-cutting feeds automatically controlled from the apron.



14-INCH "IDEAL" ENGINE LATHE

This reverse also controls the power feed for the turret on the bed, which turret has the same feed as the carriage. The latter is equipped with interchangeable compound rest, plain rest and turret. It has a taper attachment and when required, draw-in collets, backing-off attachment and other appliances are furnished. The turret on the bed is held in alinement by two table gibs; in fact all the gibs on this lathe are of the taper type. As will be noticed the bed stands in an oil pan. The lathe is built by the Springfield Machine Tool Company, Springfield, Ohio.

Device for Chasing Spring Dies

Instead of the usual method of making spring dies, this provides for a hob which cuts each prong separately as indicated in Fig. 3. A holder *A* supports the body *B*, in which is a sleeve which can turn or slide, being held by the index plate *E*.

With the holder in the tool post and the hob *D* running in the line spindle, the die is fed forward by the carriage and lead screw, while the hob cuts out the prong, as in Figs. 1 and 3. When one is cut, the index is turned, and the next prong brought into position, the die at the same time being fed forward by the screw at the back. With the hob on the center line of the die, the threads will be cut so as to bear front and back, but not in the center, and by adjusting the relative hight of the centers almost any desired bearing or back off can be obtained. This device has been patented by J. Vidina, Chicago, Ill.

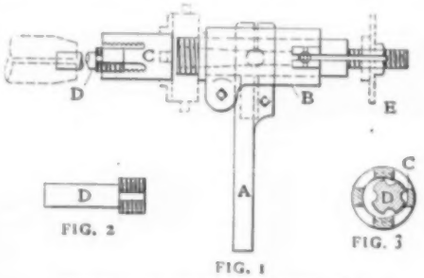


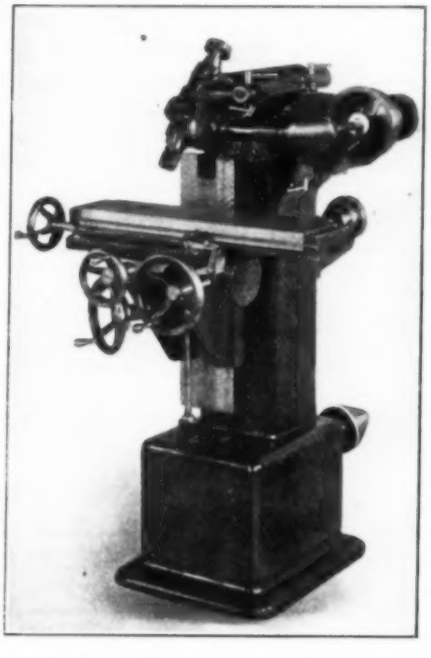
FIG. 2 FIG. 3

FIG. 1

DEVICE FOR CHASING SPRING DIES

Small Duplex Milling Machine

This is a new size of the duplex milling machine made especially for tool-room work. The general design is very similar to the larger machines, it is solidly built and has relatively long and large bearing surfaces which insure rigidity and long life. The drive is from the cone on the side of the head, through the bevel-gear connection shown. A splined shaft passes through the cone to allow the ram to be



SMALL DUPLEX MILLING MACHINE

drawn forward or moved to various positions. With the cutter spindle in a horizontal position the overhanging arm comes into play as a support. Semi-universal centers with a draw-in collet in the head can be supplied when desired. The machine weighs 1200 pounds and is made by the Waltham Watch Tool Company, Springfield, Mass.

Pneumatic Nut Tapping Machine

The main portion of this machine is the central turret which carries six taps and six facing tools, together with automatically controlled devices for stripping the nuts from the shank of the taps, so that there is no necessity for removing the taps or stopping the machine unless it is desired to do so in case of wear or breakage. In such case old taps can be removed and new ones put in place without stopping the machine.

The blanks are placed in the hoppers at each end of the machine and fed down in their proper position in a somewhat similar way to other feeding mechanisms of this kind. When a nut is presented at each side of the turret they are faced and the taps started, so that both are being operated on at the same time.

Figs. 2 and 3 show the details of the turret's construction, Fig. 2 being a vertical section through the center and Fig. 3 a top view. In Fig. 2 it will be seen that the tap holders are driven continuously by the bevel gearing from the shaft *A* up through the inside of the turret, as clearly shown. At the proper time clutch *B* is thrown in, and the turret itself revolves by the larger bevel gear. As the turret turns the toggle arms *D D* controlled by the eccentric slot beneath grip the front end of the tap and pull it out of its driving socket, far enough to allow the small fingers shown above and below the tap to strip the nut off the shank.

By this time the turret has turned to present the next pair of taps so that the action is practically continuous and two nuts are being faced and tapped at the same time.

The taps are short, being only 3½ inches long. The feeding mechanism is operated by compressed air which stops the machine should an unpunched blank present itself or one with too small a hole. The feed automatically sorts the blanks so as to present only the right side to the tap. This machine is built by the Pneumatic Nut Machinery Company, Cleveland, Ohio.

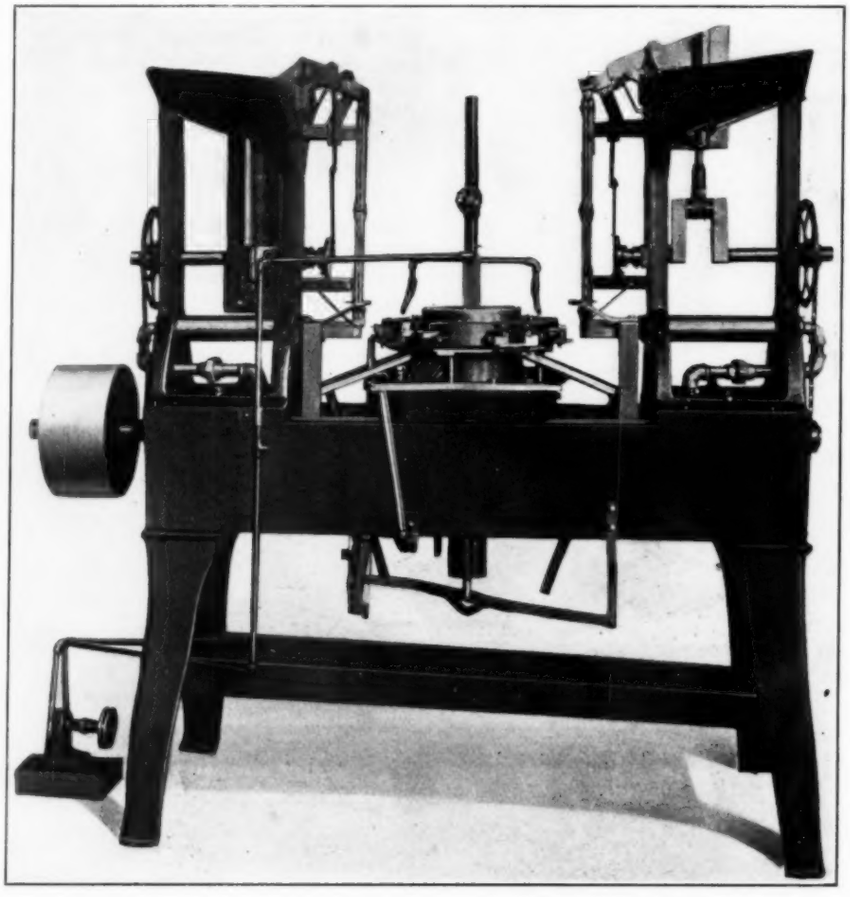


FIG. 1. PNEUMATIC NUT TAPPING MACHINE

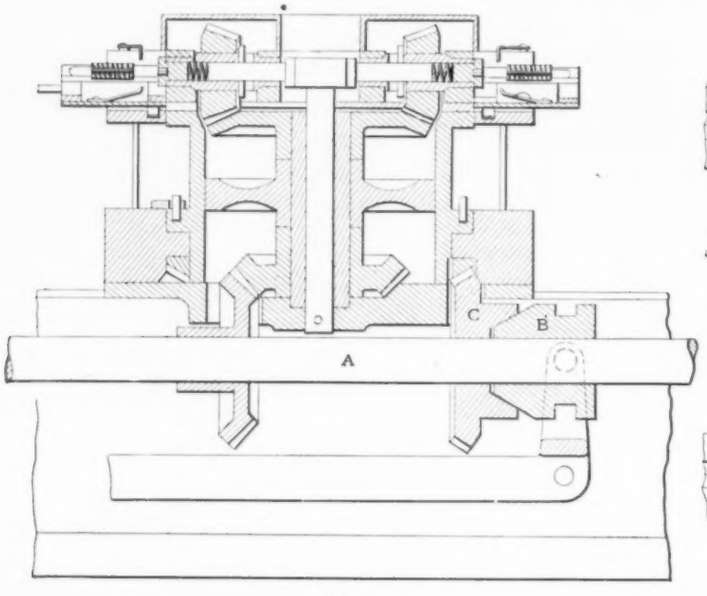


FIG. 2

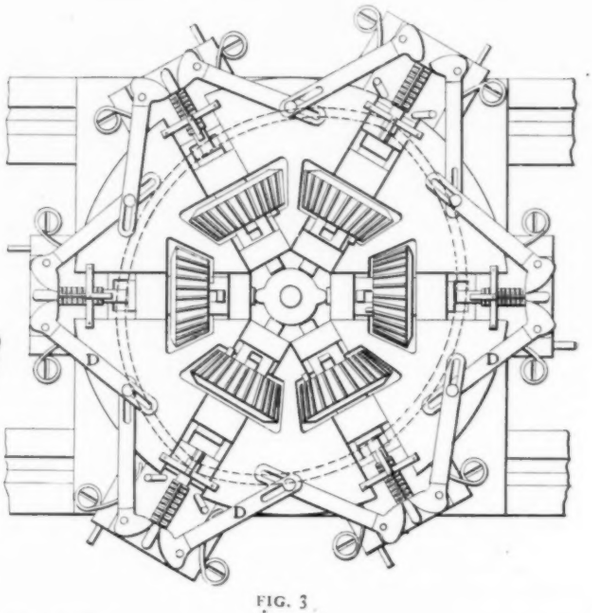


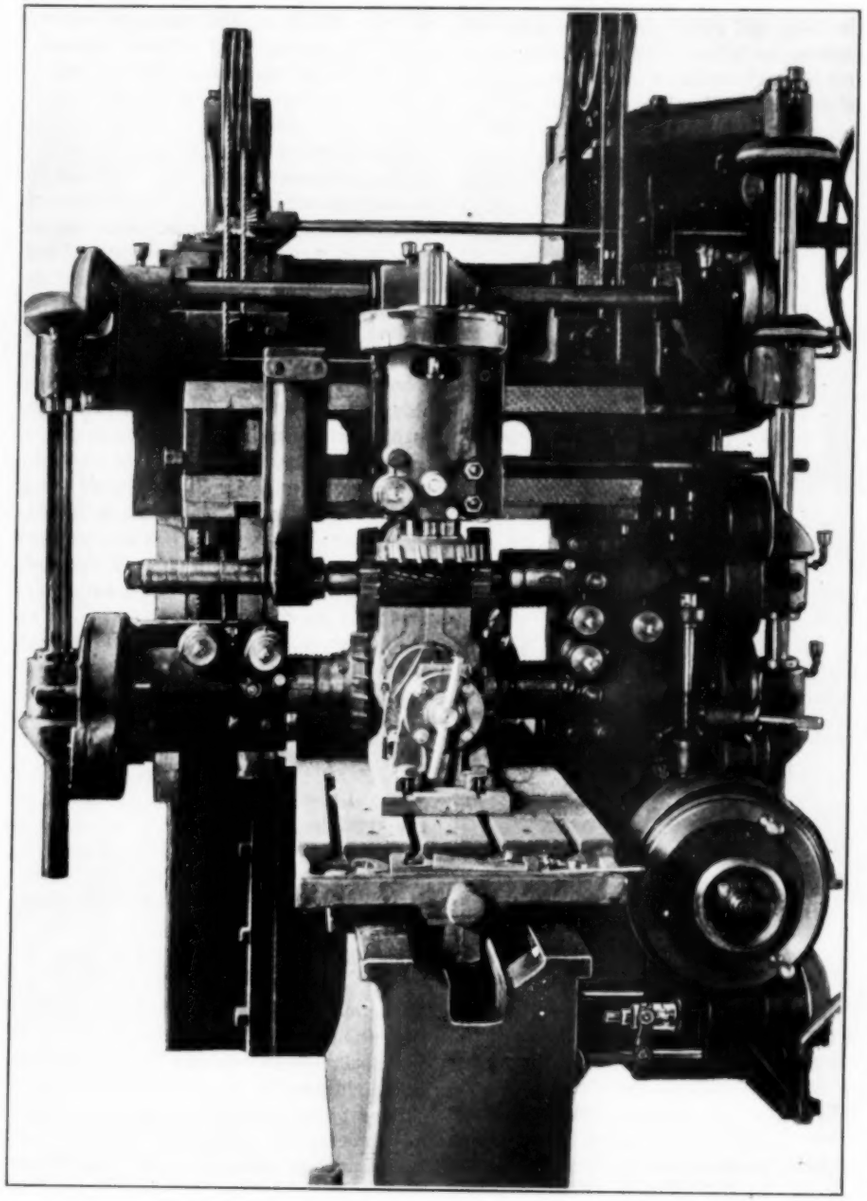
FIG. 3

DETAILS OF PNEUMATIC NUT TAPPER

Four-head Milling Machine

This is a special four-head milling machine, which has the heads differently arranged from any we have seen as can be noted. They are so arranged that the upper horizontal head on right-hand housing can be attached to the cross-rail, and in this manner drive an arbor from the face of the spindle. This arbor is supported by a support fitted to the cross-rail.

The half-tone shows the machine in actual operation on the work for which it was specially designed. The two lower horizontal heads each carry face mills. The upper horizontal head drives an arbor, which is clutched to the face of the spindle, this arbor carrying a gang of cutters. The vertical head carries a face mill. This vertical head is far enough in advance of the horizontal heads so that it is used for roughing out immediately preceding the finishing cutters carried on the arbor. It is made by the Ingersoll Milling Machine Company, of Rockford, Illinois.



FOUR-HEAD MILLING MACHINE

An interesting example of the hardness of diamonds is given in connection with the polishing operation of the great Cullinan diamond that was recently handled in Amsterdam. The disk on which the diamond was polished was made of cast iron and steel, and revolved at a rate of 2400 revolutions per minute. The diamond was pressed down on the disk, which was liberally supplied with a mixture of diamond dust and oil, by weights of 15 to 25 pounds, and the disk constantly turned from 7 a.m. to 9 p.m., for a period of nearly a year's time.

The Automobile Show in Madison Square Garden, New York.

(*Continued from Page 151*)

The transmission is selective, sliding gear, and the body is painted royal blue with upholstering to match.

The Franklin car with its air-cooled motor, each cylinder being cast separately and surrounded by copper flanges to radiate out the heat of the cylinder is another noted exception to the rule, and has likewise been successful in spite of the fact that many others have tried air cooling and failed.

The Elmore, which uses the two-cycle principle, was the only two-cycle engine shown on a pleasure automobile. It is likewise the only three-cylinder engine, as the two-cycle principle admits of a successfully operated three-cylinder engine. It was shown this year in four styles, three of which had three cylinders and one with four cylinders. These ranged in price from $1750 to $2500.

Ignition

While the great majority of the engines were ignited by the jump spark, with a spark plug that was fed from batteries, some gave the option of a high-tension magneto, and others would put it in at an extra price. A few of the higher-priced cars, however, use the make-and-break spark with the low-tension magneto.

The make-and-break spark ignition has heretofore necessitated the use of a cam shaft with its cams and gears, as well as numerous rods, bearings, levers, springs, etc., to convey the mechanical action to the cylinders to deliver the spark in the compression chamber. This has made the make-and-break spark an expensive proposition, and the numerous parts necessary has made it liable to get out of order.

This mechanism has all been done away with by an automatic magnetic sparker which has just been brought out by the Bosch Magneto Company, of Germany. This magnetic sparker is shown in the half-tone screwed into the top of the engine of the Garford Company, as it was exhibited on the Studebaker automobile at the show. As will be seen, the mechanism mentioned above has all been done away with and in its place is a hard rubber tube that holds the wires which conduct the current from a distributor on the end of the magneto to the plugs. Inside of these plugs the current is "made" and "broken" by a very simple fork that moves back and forth automatically.

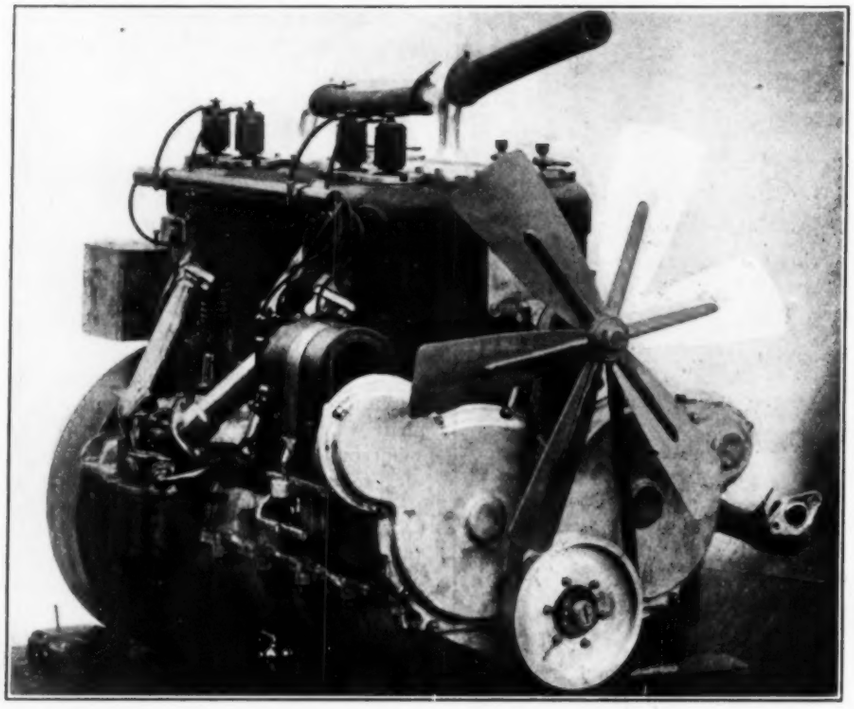
Cylinders and Clutches

Over 85 of the cars shown had four cylinders, 22 had six cylinders, two had one cylinder and three had three cylinders. Of these the Elmores were the only three-cylinder cars, and the Cadillac and Waltham were the only one-cylinder cars. The 22 cars with six cylinders were made

by eight different manufacturers; of these seven showed four-cylinder cars as their main product, while one, namely, the Winton Motor Carriage Company, showed nothing but six-cylinder cars, which they called the "Winton Six."

Most of the four-cycle, four and six cylinders were cast in pairs, and it would seem that this was developing into a standard, but seven of the makers exhibited engines with each cylinder cast separately. Of course, the air-cooled engine is of necessity cast in separate cylinders, and this is not included in the above. The two-cycle Elmore also cast their cylinders separate and are not included.

The Corbin give a choice of their four cylinder car cast separate, or in pairs, and the Stevens-Duryea, Pierce and Hewitt give a choice of the six-cylinder engine



MAGNETIC MAKE-AND-BREAK SPARKER ON THE GARFORD COMPANY AUTOMOBILE ENGINE

cast separate, or in pairs, while these three make their four-cylinder car cast in pairs. The Thomas car differed from all of the rest at the show by having their four cylinders cast all in one piece and their six cylinders cast in threes.

The multiple-disk clutch is growing in favor, and this year nine of the auto builders showed it on their cars, while two had the three-plate clutch, which is a simple form of the multiple disk, while 11 makers used the cone clutch, which was the original form, and has been used for some time. The band or ring clutch was used by seven builders, five of whom used the expanding band and two the contracting.

Tool Exhibit

In the accessories part of the show a novelty was introduced by two of the machine-tool builders showing some of their machines in operation.

Pratt & Whitney Company had a vertical surface grinder, that would hold work 15x36 inches, turning out work. They also exhibited a spline miller and a 6x48-inch thread miller.

Garvin Machine Company showed the first one of their new No. 2—C universal millers. This machine is fitted up with a planetary-gear change-speed box, and all of the speeds forward and back can be obtained by turning a crank on the side of the machine without stopping it. They also exhibited for the first time a brand new "stop and open" chuck, which is very quick in its action. This was shown on their No. 22½ monitor, or chucking, lathe, which had some improvements on the turret and tool stops. Besides this they showed their No. 12 plain miller, No. 14 vertical spindle miller, rapid screw slotter, and No. 22 monitor headstock.

Small tools and hand tools were shown by the Noonan Tool and Machine Works, Eclipse Machine Company, Aurora Automatic Machine Company, Nightingale Whistle Manufacturing Company, S. F. Bowser & Co., Veeder Manufacturing Company, Coes Wrench Company, Perfection Wrench Company, the Lever Company, and Patterson, Gottfried & Hunter. Some of these had small tools on sale.

Iron and Steel Castings

Castings were exhibited in large numbers and by many foundries and casting makers. These were exhibited in all the different metals used on an automobile and in all sizes from the six-cylinder crank cases to the small die-molded castings.

The cast-iron exhibits showed some very good work. The metal shown in some of the cylinder castings that were sawed up to show the quality of the metal gave an indication of the progress that has been made in this line.

But a few years ago it was almost impossible to get iron cylinder castings in this country, that were light enough and at the same time strong enough to serve the needs of automobile building. The quality of the iron shown in the castings at this exhibition, however, proves that there are any number of iron foundries that are now capable of turning out as good castings as can be obtained anywhere.

The steel castings exhibited were an eye-opener to many engineers, as they did not think that steel castings could be produced of the quality that were shown here. In fact, one engineer, after looking over the castings shown by the Lebanon Steel Foundry, said he did not believe they could produce these commercially, and yet the castings they showed were taken from lots that had been shipped to customers. One steel casting in particular was about 6 inches in diameter over all and had from 12 to 18 blades cast around its periphery that were about 1 inch square and ⅛ inch thick nearest the center, but tapered down to 1/16 inch at the outer edge. The rim of the casting was but ⅜ inch thick and the blades projected past this rim on three sides.

Another casting in this same exhibit that attracted a great deal of attention was a universal-joint star. The four arms on this were finished and they showed as good metal as would be possible to obtain in a forging, or any other way. These castings were all made by the crucible process.

The Flexilis Works steel castings, of Germany, that were exhibited by Henry Hess, also attracted considerable attention.

Aluminum and Alloy Castings

Aluminum castings were shown by several foundries, and these have been very materially improved upon both in strength and lightness by the addition of several different alloys, such as magnesium, nickel, manganese, etc. The Light Manufacturing Company showed a new alloy which they are now casting that had magnesium added to their aluminum and for this they claim greater strength and lightness.

McAdamite metal was exhibited in five different alloys and a large number of castings. Parsons white bronze and manganese bronze was shown in a large exhibit by the Cramps. Isaac G. Johnson & Co. showed the new monel metal, which is a composition of copper and nickel, as well as their well known steel castings.

Many other special alloy metals were also shown in bronze, of which Reeves, Tubal manganese bronze was one, and white metals. Among these were the Franklin, Veeder and Wetherill die castings, which are now being used quite extensively for automobile parts, especially bearings.

Miscellaneous Exhibits

Ball and roller bearings were exhibited by nearly all of the makers, and among them were several new ones.

Automobile chains were exhibited by the Whitney Manufacturing Company, Baldwin Chain and Manufacturing Company, and Diamond Chain and Manufacturing Company.

Lamps, ignition apparatus, carbureters, shock absorbers, horns, radiators, wheels, rims, etc., were exhibited by many makers and in a profusion of styles.

The Dow dismountable rim is worthy of special mention as it was exhibited for the first time and is very simple. It can be taken off and put back on by one having no experience in from 18 to 20 seconds.

The Automobile Engineers' Meeting

The first session of the automobile engineers' fourth annual meeting was held in the A. S. M. E. rooms, on Thirty-ninth street, New York City, on January 5, 1909, which was during the automobile show at Grand Central Palace, and the second session was held on January 19, 1909, which was during the automobile show at Madison Square Garden. President Henry Hess presided at both sessions and seven papers of special interest were presented and discussed.

The first paper presented was "The Economies of Weight Reduction," by F. D. Howe, and in this he showed that each pound of weight cost something for gasolene to move it around, for the wear on tires to carry it, for the wear on clutches in starting and brakes in stopping it, and increased the time required to get up speed as well as reduced the hill-climbing ability.

By estimating the average life of a car at 50,000 miles and averaging up the cost of gasolene and tires he showed that each pound of weight carried would cost 40 cents for tires and 12.5 cents for gasolene, a total of 52.5 cents, and the cost of the wear of other parts might be figured as the interest on this. This should show the necessity of cutting the weight down as low as possible by using good materials, but there is a limit to the weight cutting that is based on strength and the extra cost of the materials.

Compression Coupling

The second paper was "An Improved Type of Compression Coupling," by William S. Noyes. He said the ideal joint for the automobile must be proof against vibration and jolting, and must allow of its being coupled or uncoupled without difficulty, all of which this improved type was capable of, and it does away with the necessity of threading, soldering, flaring the tube or other preparatory processes.

The coupling consists of a sleeve tapered on the inside. Inside of this fits another tapered sleeve that is drawn into the first sleeve by a nut, thus forcing it to tighten around the pipe and grip it with a pressure that is proof against leakage up to 1000 pounds pressure. By unscrewing the nut the pipe is immediately released and can be uncoupled. Its use for gasolene, oil and water lines has eliminated much of the troubles caused by leakage.

The third paper was "The Modern Trend of Brake Design," by Lawrence Whitcomb and Thos. J. Fay, and went into the subject very thoroughly by comparing clutches and brakes, analyzing the virtues of power and speed, the coefficient of friction, the heat arising from the contact, the kind of shoe best suited, and emergency conditions that might be met with. It also gave many formulas for the proper designing of brakes.

Ignition

The fourth paper was "What Constitutes Ignition Reliability," by A. Atwater Kent. In this he showed that the car of today is the exception that does not have from $30 to $50 spent on it per annum for renewals for the ignition system and repairs thereto, but that it should be made as reliable as other parts of the car that are overhauled only once a year or once in three years as the case may be.

He said the several requirements of a reliable ignition apparatus may be grouped under three heads: 1, Reliability of current supply; 2, mechanical regularity of action; 3, freedom from mechanical wear and tear.

The most reliable current-supply producer for ignition purposes is the low-tension magneto if well made and carefully insulated, and the other two are the high-tension magneto and batteries.

Of the mechanical regularity in action, the make-and-break contact in the primary circuit gives the poorest results owing to the fusion of metal particles by the spark on separation and to the transfer of metal from one contact to the other. The greater the volume of current flow the more frequent will filing and renewal be needed.

The high-tension magneto is ideal for the second requirement, but fails for the first, and, therefore, has to be coupled with batteries so the car can get its proper ignition at slow speed and not be stalled when in crowded streets with plenty of traffic to work its way through.

With the make-and-break system the mechanical wear and tear is large, as each cylinder needs a pair of contacts that are operated by their own cams on a cam shaft, and when the moving parts of the igniter have worn loose the spark time is likely to be affected.

The battery system will not be good until we can devise one that will retain the constant-spark advantages and shall be able to match the magneto's regularity with less than the magneto's liability to wear. If we can devise a contact mechanism which, while saving the battery will last indefinitely and, therefore, cost nothing after the first cost, we would be willing to accept the limited life of the battery and the cost of renewing it two or three times a season.

Motor Bearings

The fifth paper was "Standardizing Motor Bearings," by S. P. Wetherill, Jr., who said that he thought the time had come for a standardization of the bearings, and that this should be based on three essential conditions:

1. A metal must be decided upon which, while inexpensive enough to hold its own with cheap babbitt for relatively light duty, is still of the highest quality obtainable to stand the maximum requirements of overloading.

2. The range of sizes must be wide, and the variations by the smallest possible steps, so that the designer will never have to make serious sacrifices in order to avail himself of the standard.

3. The cost of the bearings must be such as to convince the manufacturer that he cannot afford to make his own bearings.

The best metal could be obtained from data on the coefficient of friction, the rigidity under compression, the hardness, the melting point, and the lubricating properties and the metals which have given the best satisfaction under actual road conditions could be obtained from the different motor-car makers.

The second condition could be met by making some 300 sizes with progressive increments for shaft diameter of sixteenths of an inch, and for length of bearings of eighths of an inch, and these could be made in either split bushings or for whole round ones. The oil grooves could be made to an acceptable standard or left out entirely.

If the bearings were standardized their cost could be made low enough to convince the manufacturer that he could not afford to make his own by adopting the die-casting method of making them, which is capable of producing them to the actual finished size with a variation of less than 0.001 inch, thus doing away with all machine work.

Autogenous Welding and an Indicator

The sixth paper was "Some Practical Considerations in Autogenous Welding," by Henry Cave. With this paper a demonstration was given in welding cast iron, steel, iron to steel, aluminum, and on the

cutting of metals. The paper was considered of so much interest to the readers of the AMERICAN MACHINIST that it is given nearly in full in another part of this paper.

The seventh and last paper was "An Indicator with Continuously Rotating Drum," by S. W. Rushmore and Herbert L. Towle. This paper described a new indicator, and its methods of operation and taking of readings, that was designed by them and in which the rotation of the drum and revolutions of the crank bear a fixed relation to each other.

This mechanism requires no connection to the engine except an ordinary pipe fitting screwed into the cylinder head and can, therefore, be attached in a few minutes and readings taken while the car is running over the road.

By running the drum at constant speed and holding a pencil against it for an instant a record is obtained of the pressures during the four strokes of the cycle. It is an application of the piston and pencil movement of a high-speed steam-engine indicator by connecting it to a drum.

Business Items

The Shepard Electric Crane and Hoist Company, Montour Falls, N. Y., has established a Western office at Room 1775 Old Colony building, Chicago.

We acknowledge with thanks receipt of calendars from Milton Manufacturing Company, Milton, Pennsylvania, and Taylor Iron and Steel Company, High Bridge, N. J.

The southern branch of the American Steam Gauge and Valve Manufacturing Company, for several years located in the Equitable building, Atlanta, Ga., has removed its office to 524-525 Candler building, of that city

John L. Wagner, lately with the Multi-Vending Company, Chicago, has purchased an interest in the Barbieri & Dellenbarger Company, which recently moved to larger quarters at 776-778 Clybourn avenue, Chicago, opposite its former location. Mr. Wagner will be vice-president and manager of the company.

The Rockwell Furnace Company has been awarded the contract covering the complete furnace equipment for the new locomotive shops of the Delaware, Lackawanna & Western Railroad, at Scranton, Penn. The furnace equipment consists of 35 of the latest type furnaces operated with 300 B.t.u. water gas, which is made in Loomis-Pettibone producers.

At the annual meeting of the directors of the Independent Pneumatic Tool Company the following officers were elected: James B. Brady, president; W. O. Jacquette, 1st vice-president; John D. Hurley, 2d vice-president; A. B. Holmes, secretary and treasurer. The annual report showed that during the quarter ending December 31, 1908, 40 per cent. more business was transacted than during the corresponding period of 1907.

Announcement has been made of the consolidation of American Blower Company, of Detroit, and Sirocco Engineering Company, of New York. All business will hereafter be transacted under the name of American Blower Company, with main offices at Detroit. The following officers will be in charge: James Inglis, president; Wm. C. Redfield, vice-president; Chas. H. Gifford, treasurer; Mr. Still, secretary.

W. S. Nicholls, 253 Broadway, N. Y., reports growing demand for the Hercules portable crane hoist. Among orders received are those of the Tennessee Coal, Iron & Railway Company, Gisholt Machine Company, National Acme Manufacturing Company, Inland Steel Company, Westinghouse Machine Company, Illinois Steel Company, Union Switch and Signal Company, American Steel and Wire Company, Northern Engineering Works, Edison Illuminating Company, Hendey Machine Company, Monarch Road Roller Company, New York Transportation Company, New York Taxicab Company, Dean Electric Company and H. H. Franklin Manufacturing Company.

Nearly seventy men were in attendance at the annual convention of the officers, department managers, branch managers and salesmen of Manning, Maxwell & Moore, Inc., which was held at the Hotel Astor, 45th street and Broadway, New York, January 8 and 9. Representatives from foreign countries enlivened the sessions with accounts of the progress made there. The manufacturing end was represented by the works managers of the following subsidiary companies: Shaw Electric Crane Company, Muskegon, Mich.; The Ashcroft Manufacturing Company and the Consolidated Safety Valve Company, Bridgeport, Conn.; the Hancock Inspirator Company and the Hayden & Derby Manufacturing Company, Boston, Mass.

Trade Catalogs

H. H. Franklin Manufacturing Company, Syracuse, N. Y. Catalog of automobiles. Illustrated, 36 pages, 8x10½ inches, paper.

General Electric Company, Schenectady, N. Y. Bulletin No. 4637, describing Tungsten lamps for battery service. Illustrated, 8 pages, 8x10½ inches.

The Wallace Barnes Company, Bristol, Conn. Catalog of small springs, wire and cold rolled steel, washers. Illustrated, 34 pages, 5½x7 inches, paper.

National Tube Company, Frick building, Pittsburg, Penn. Book entitled, "Shelby Steel Tubes and Their Making." Illustrated, 46 pages, 8x10 inches, paper.

Tate, Jones & Co., Inc., Pittsburg, Penn. Booklet entitled, "Oil vs. Coal," describing oil burning appliances and furnaces. Illustrated, 16 pages, 6x9 inches, paper.

International Engineering Company, of New Jersey, 1779 Broadway, New York. Catalog of R B F radial and thrust ball bearings. Illustrated, 24 pages, 6x9 inches, paper.

Consolidated Press and Tool Company, Hastings, Mich. Catalog No. 5, describing power presses and other sheet metal working tools. Illustrated, 168 pages, 6x9 inches, cloth.

Hoefer Manufacturing Company, Freeport, Ill. Catalog describing drill presses, power metal saws, vertical boring machines, horizontal drilling and boring machines. Illustrated, 48 pages, 6x9 inches, paper.

The Burke Machinery Company, Cleveland, Ohio. Catalog of milling machines, drill presses, tapping machines, coal oil forge. Illustrated, 4x7 inches, paper. Circular describing improved cutting-off saws and saw grinder. Illustrated.

D'Olier Engineering Company, 119-121 S. 11th street, Philadelphia, Penn. Leaflet No. 10, illustrating and describing steam turbines. Bulletin-Series T. No. 9, describing horizontal centrifugal pumps. Illustrated, 8 pages, 6½x10 inches.

Business Opportunities

The Rockford (Ill.) Machine & Shuttle Co. will build a new plant in the spring.

White & Yokum, Edgemont, Ark., will establish planing and molding mill.

The F. W. Dodd Structural Iron Company, Des Moines, Iowa, will enlarge its plant.

The Empire Iron and Steel Company, Niles, Ohio, is to erect two additional hot mills.

The plant of the Memphis (Tenn.) Machine Company, recently burned, is to be rebuilt.

The Central Machine and Metal Company has moved from Moline to Rock Island, Ill.

The Lenoir (N. C.) Chair Company will add new equipment in order to increase output.

The International Nut Company, Niagara Falls, N. Y., is planning to build an addition.

W. H. Baker, Winnfield, La., will erect plant for the manufacture of sash, doors and blinds.

Morris & Marshall, Pell City, Ala., will establish plant in Gadsden for manufacturing shovels.

The Virginia Spoke and Handle Company, Martinsville, Va., will rebuild plant recently burned.

It is stated that the Gruber Boiler and Machine Works, Ft. Wayne, Ind., is planning an addition to plant.

The Dickson Car Wheel Company, Houston, Tex., has purchased more land for the purpose of extending plant.

The Wheeling (W. Va.) Mold and Foundry Company, it is said, contemplates erection of 150-ton iron furnace.

The Atlanta (Ga.) Safe and Lock Company has been incorporated by R. W. Ellis, M. Ellis and E. E. Culclasure.

The Ohio State Stove Company, Columbus, Ohio, has been incorporated with $75,000 capital. F. U. Long, president.

The Hawley Down Draft Furnace Company, Chicago, Ill., is to erect a branch plant in Salt Lake City at a cost of $200,000.

The Abilene & Southern Railway Co., will erect roundhouse at Abilene, Tex., it is said. Percy Jones, Abilene, chief engineer.

James R. Clow & Sons Co., Coshocton, Ohio, has let the contract for construction of new pipe plant. This calls for twelve buildings.

The Commercial Museum, Milan, Italy, is desirous of obtaining quotations and literature on machinery for making cut and wire nails.

The Wichita (Kans.) Natural Gas Company has completed plans for the construction of a relay compressing station to cost $100,000.

The Carborundum Company, Niagara Falls, N. Y., will erect a four-story addition to plant in order to take care of increasing business.

The Texas & New Orleans Railroad has made arrangements to rebuild roundhouse in Beaumont, Texas, destroyed by fire some time ago.

Sasi Basak, 2 Basak's street, Calcutta, India, would like quotations and catalogs on machines for turning out about 35,000 one-half inch rivets daily.

The Huntingdon Wood Manufacturing Company, Huntingdon, Tenn., has been organized to manufacture boxes, crates, etc. Jas. M. McCall, president.

The West Penn Steel Company is letting contracts for construction of plant at Tarentum, Penn. This will cost about $500,000. J. W. Burdick is president.

The planing mill of the Richards Construction Company, at Industrial a suburb of Charleston, W. Va., was destroyed by fire, causing $10,000 loss. It will be rebuilt.

The McLaughlin Manufacturing Company, of Philadelphia, Penn., has secured site at Elwood City on which a plant for the manufacture of interlocking steel rail will be erected.

The River Furnace and Dock Company, Cleve-

land, Ohio, a new corporation organized by Corrigan, McKinney & Co., will soon start the erection of two furnaces to cost $2,000,000.

Karl Weiss & Co., Leonberg, near Stuttgart, Wurttemberg, Germany, manufacturing wheelwrights' and carriagemakers' supplies, is interested in woodworking machinery of all kinds.

The Edward Payson Manufacturing Company, Traverse City, Mich., manufacturing door locks, etc., will enlarge plant. A new foundry building and lock shop will be erected.

The Hygiene Metal Cabinet and Manufacturing Company, Evansville, Ind., has been incorporated by Charles and John Schroeder, etc. A two-story brick factory building will be erected.

The Crescent Emery-Corundum Wheel Company, Indianapolis, Ind., has been organized to manufacture abrasive materials. R. O. Rupert, Sr.; C. G. Brown and J. F. Elliott, Jr., incorporators.

The H. E. Mills Manufacturing Company, Syracuse, N. Y., making core compound, etc., has decided to erect a new factory to replace the one burned some time ago. About $60,000 will be expended.

The Oklahoma Stove and Structural Iron Company, Oklahoma City, Okla., recently incorporated, will erect plant which is to have a daily capacity of 12 to 15 tons stove and structural iron. W. H. Watkins, president.

The Goldschmidt Detinning Company, 60 Wall street, New York, has been incorporated with $3,000,000 capital and is arranging to build a large plant on Staten Island Sound, near Carteret, N. J., for detinning tinplate scrap.

The Thomas Iron and Steel Company has been formed at Pittsburg, Penn., with $500,000 capital and will take over the plants of the Niles Iron and Steel Company, at Niles, Ohio, and the Niles Corrugating Company, W. A. Thomas, president.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., February 8, for manganese steel, chain, lead melting furnace and ladles, pipe cutting machine, post and twist drills, taps, reamers, stocks and dies, pipe cutters, wrenches, vises, hammers, punches, chisels, tool handles, files, screws, cotters, oil cans, etc., as per Circular No. 490.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: February 2—Leather belting (schedule 845, 832), twist drills (schedule 832, 851), high speed reamers, drill sockets (schedule 833), band saws (schedule 851), bar steel (schedule 834, 850), brass and copper tubing (schedule 832, 835, 846). February 9—Engine lathe (schedule 841). February 23—Foundry crane (schedule 840), engine lathe (schedule 838).

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E. G. Smith Co., Columbia, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

For heavy engineering specialties to manufacture on royalty. Box 878, AMER. MACH.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Machinery built to order; up-to-date plant. Write Brunswick Refrigerating Co., New Brunswick, N. J.

Machines designed; automatic, special. Practical working drawings. C. W. Fitman, 3519 Frankford Ave., Philadelphia, Pa.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J Emory & Co., Newark, N. J.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MACH.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

ILLINOIS

Tool room foreman desires change; first class on tools for adding machines, cash registers and typewriters. Box 764, AM. MACH.

Practical draftsman and designer, nine years' experience on special machinery, tools, jigs, fixtures, etc. A-1 references. West preferred. "F. E. H.," 4233 Prairie Ave., Chicago.

INDIANA

Superintendent—Practical machinist and toolmaker. Wide experience handling men and producing results. Age 38. Now employed. Will go anywhere. Box 877, AMER. MACH.

MASSACHUSETTS

I wish to correspond with any company desiring the services of a progressive and up-to-date manufacturing superintendent. Box 864, AMERICAN MACHINIST.

Graduate mechanical engineer, first class designer with excellent experience in steam turbines, pumps and general machinery, would like position as designing engineer or chief draftsman. References of well known concerns. Box 850, AMERICAN MACHINIST.

NEW JERSEY

Draftsman desires change, executive ability; 12 years' experience in designing and developing automatic machines. Box 881, AMERICAN MACHINIST.

NEW YORK

Mechanical draftsman, expert in pumping machinery, wants a position. Box 876, AM. MA.

Brass and bronze foundry foreman desires situation. Practical melter, coremaker and molder. French or American methods. Address "Bronze," AMER. MACH.

Mechanical draftsman; 25; wishes to change position; 6 years' broad experience at automatic and general machine work. Box 880, AMERICAN MACHINIST.

Position as model maker on guns, sewing or voting machines, or experimental work; 25 years' experience; best references. Box 886, AMERICAN MACHINIST.

Mechanical engineer, six years experience in general engineering work, desires position near New York City. Salary moderate. Box 874, AMERICAN MACHINIST.

General foreman, 22 years' practical experience; expert on steam engine and general work; thoroughly versed in best shop practice; can handle men to advantage and produce results. Box 852, AMER. MACHINIST.

Mechanical engineer, graduated, experienced one year in turbo-compressors and pumps in America, seven years in Europe in steel millings and blast furnaces. Independent designer from steady position; wishes to change. Box 868, AMERICAN MACHINIST.

Position wanted by electrical engineer, technical graduate, capable of managing and laying out alternating and direct-current power distribution for shops and plant, machine tool expert. Over seven years' experience with large electrical manufacturers. Box 879, AMERICAN MACHINIST.

PENNSYLVANIA

Position as foreman of machine tools, erecting shop or both, well up on Corliss engine and other large work. Best references. Good salary required. Box 873, AMERICAN MACH.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—A live man in every large machine trade center to handle on commission a new and quick selling small tool. Must have trade acquaintances and furnish local references. Box 869, AMERICAN MACHINIST.

ILLINOIS

Superintendent for screw machine factory. Must be thoroughly competent. Fine opportunity for the right man. Duce Mfg. Co., care Chas. T. Frantz, 505 Commercial National Bank Bldg., Chicago.

Wanted—General foreman for the power apparatus shops. Applicant must have good mechanical and executive ability; one with experience in the manufacture of generators and motors preferred, though this is not a necessity. Apply by mail only, stating age, experience in full detail and salary expected. Personal interview may be arranged for later. Address Department No. 29, Western Electric Company, Chicago.

MASSACHUSETTS

Wanted—Experienced mechanical draftsman for special machines and tools; must be quick to grasp ideas and capable of correct and rapid drawings. Box 883, AMER. MACH.

MICHIGAN

Wanted—Experienced operator on Potter & Johnson turret machines, who is competent to take charge of several machines, turning out good work advantageously. State experience handling men, wages, age, nationality. We want a man who can turn out a maximum amount of good work. Box 838, AM. M.

MISSOURI

Wanted—Draftsman who has had experience in designing double acting, horizontal gas engines; in application state age, education, experience in detail and salary expected. Box 871, AMERICAN MACHINIST.

NEW JERSEY

Salesman—A traveling salesman who is now selling the machine or railroad supply trade, to carry a high grade bearing metal (babbitt) as a side line, on liberal commission basis. Address, with full particulars, Lakewood Metal Co., Box 182, Lakewood, N. J.

In our rapidly growing business of the manufacture of a well known article, we always have openings for draftsman and tool makers on small tools, jigs, sub-press dies and special machinery. We invite applications from first-class men on this kind of work. Box 884, AMERICAN MACHINIST.

NEW YORK

Wanted—First class drop-forging die sinkers. Working conditions attractive. Address, with reference and salary, Box 870, AMER. MACH.

Wanted—First-class toolmakers, experienced on all-round tool and die work, who can produce work quickly and accurately. No others need apply. Box 885, AMERICAN MACHINIST.

OHIO

Toolmaker; one competent to make tools for rolling and drawing sheet metal. Box 791, AMERICAN MACHINIST.

Wanted—Competent sales manager by a machine tool manufacturer. Liberal salary to a very high class man. Box 833, AMER. MA.

Wanted—Superintendent metal working plant. Must have thorough knowledge shop system, mechanical training and ability to handle men. Answer fully, giving experience and salary. Address C. A. Nibot, 117 Woodbine Avenue, Youngstown, Ohio.

PENNSYLVANIA

Wanted—Technically educated draftsman and checker. Must be experienced, speedy and capable of securing satisfactory results on gas engine work. Box 875, AMERICAN MACHINIST.

Wanted—Traveling inspector to trace and chase in automobile parts; must be of good address, energetic, sober and thoroughly familiar with machine inspecting practice; give reference and salary desired. Box 854, AM. M.

Wanted—A case hardener. Must be thoroughly familiar with cyanide and pack hardening of steel punchings, machinery steel pinions, hubs, gears, etc. Preferably a man who has had several years' experience on gun work desired. Box 872, AMERICAN MACHINIST.

For Sale

For Sale—Greenfield Universal tool and cutter grinder, at a bargain. As good as new. Box 837, AMERICAN MACHINIST.

For Sale—A solid brick, steel construction, factory building, with 7½ acres of land near Chicago. Now unoccupied. Size 110x541. Suitable for iron working business. Has engine, boilers, dynamos, etc. Most favorable prices and terms will be given. Chicago Highlands Association, 1315 Wells Building, Milwaukee, Wis.

For Sale—36x36x12 planer, 2 heads, 24" shaper, 36" drill press, 1¼" P. & W. automatic, ¾" P. & W. automatic, 24"x12' lathe; A-1 condition. Box 834, AMERICAN MACHINIST.

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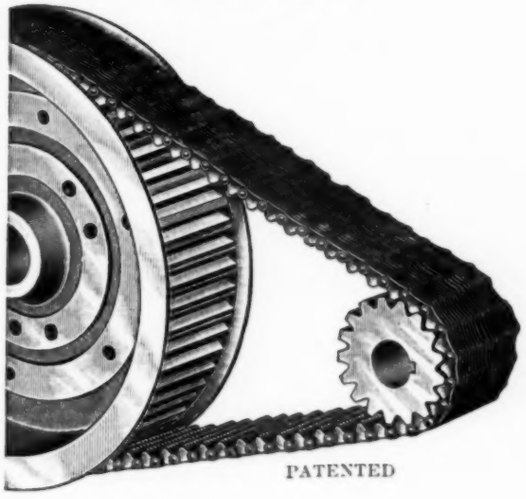

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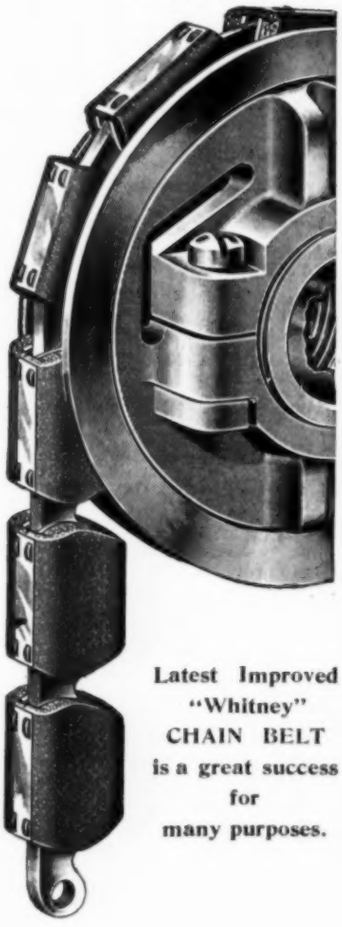

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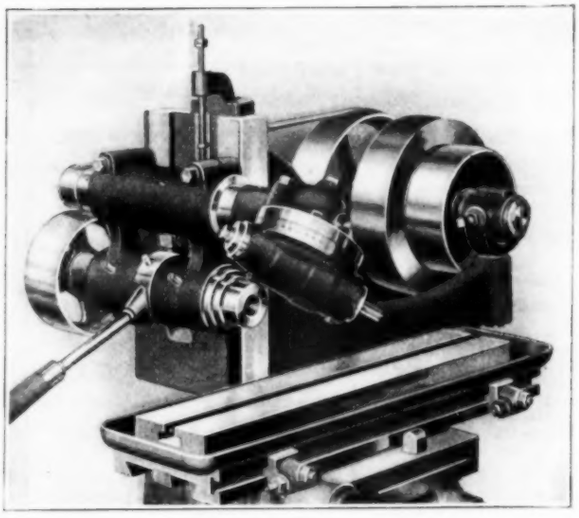

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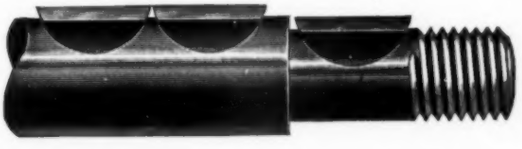

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Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Lang Co., G. R., Meadville, Pa.

Bolts and Nuts

Electric Welding Products Co., Cleveland, Ohio.
Milton Mfg. Co., Milton, Pa.
National-Acme Mfg. Co., Cleveland, O.

Bone for Case Hardening

Rogers & Hubbard Co., Middletown, Conn.

Books, Technical

American School of Correspondence, Chicago, Ill.
Hill Publishing Co., New York.
Sames, Chas. M., Jersey City, N. J.
System, Chicago, Ill.

Boosters

Burke Electric Co., Erie, Pa.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal

Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Betts Mach. Co., Wilmington, Del.
Detrick & Harvey Mach. Co., Wilmington, Del.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Inc., Boston, Mass.
Lucas Mach. Tool Co., Cleveland, O.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Newton Mach. Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Universal Boring Mach. Co., Hudson, Mass.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Boring and Turning Mills, Vertical

American Tool Works Co., Cin., O.
Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mach. Tool Co., Franklin, Pa.
E. J. Flather Mfg. Co., Nashua, N. H
Gisholt Mach. Co., Madison, Wis.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Mitts & Merrill, Saginaw, Mich.
Newton Machine Tool Wks., Inc, Phila., Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Boring Tools

Armstrong Bros. Tool Co., Chicago, Ill.
Krieger Tool & Mfg. Co., Chicago, Ill.

Box Tools, Roughing

Bardons & Oliver, Cleveland, O.

Brazing

Industrial Oxygen Co., New York.
Sanford Mfg. Co., F. C., Bridgeport, Conn.
Universal Fluxine Co., Urbana, Ohio.

Broaching Machines

Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Inc., Boston, Mass.
Lapointe Mach. Tool Co., Hudson, Mass.

Buckets, Coal

Link Belt Co., Philadelphia, Pa.

Bulldozers

Bliss Co., E. W., Brooklyn, N. Y.
National Machinery Co., Tiffin, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Cabinets, Tool

Armstrong Bros. Tool Co., Chicago, Ill.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Calipers

Brown & Sharpe Mfg. Co., Providence, R. I.
Schuchardt & Schutte, New York.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Cams

Bilgram, Hugo, Phila., Pa.
Boston Gear Works, Norfolk Downs, Mass.
Fuller Mfg. Co., New Haven, Conn.

Carborundum

See Grinding Wheels.

Carborundum Paper and Cloth

Carborundum Co., Niagara Falls, N. Y.

Cars, Industrial

Link Belt Co., Philadelphia, Pa.

Case-Hardening

American Gas Furnace Co., New York.
Rogers & Hubbard Co., Middletown, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Castings, Brass and Bronze

Clum & Atkinson, Rochester, N. Y.
Lumen Bearing Co., Buffalo, N. Y.

Castings, Die Molded

Berry & Parker, Erie, Pa.
Franklin Mfg. Co., H. H., Syracuse, N. Y.

Castings, Iron

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Buffalo Fdry. & Mach. Co., Buffalo, N. Y.
Cell Drier Machine Co., Taunton, Mass.
Erie Foundry Co., Erie, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Link Belt Co., Philadelphia, Pa.
Taylor & Fenn Co., Hartford, Conn.

Castings, Steel

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Cammell Laird Co., New York.

Cast Iron Brazing

Industrial Oxygen Co., New York.

Cement, Cast Steel

Clark Cast Steel Cement Co., Shelton, Conn.
Obermayer & Co., S., Cincinnati, O.

Cement, Iron

Smooth-On Mfg. Co., Jersey City, N. J.

Centering Machines

Hendey Mach. Co., Torrington, Conn.
McCabe, J. J., New York.
National Machine Co., Hartford, Conn.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Mach. Co., D. E., New London, Conn.

Centers, Planer

Cincinnati Planer Co., Cincinnati, O.
Fay & Scott, Dexter, Me.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving

Boston Gear Works, Norfolk Downs, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Link-Belt Co., Philadelphia, Pa.
Morse Chain Co., Ithaca, N. Y.
Whitney Mfg. Co., Hartford, Conn.

Chucking Machines

American Tool Wks. Co., Cin., O.
Bardons & Oliver, Cleveland, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Machine Co. Cleveland, O.
Garvin Mach. Co., New York.
Gisholt Machine Co., Madison, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Reed Co., F. E., Worcester, Mass.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill

Almond Mfg. Co., T. R., Ashburnham, Mass.
Brown & Co., R. H., New Haven, Conn.
Celfor Tool Co., Chicago, Ill.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Morrow Mfg. Co., Elmira, N. Y.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt Chuck Co., Frankfort, N. Y.
Russell Anti-friction Drill Chuck Co., Elmira, N. Y.
Skinner Chuck Co., New Britain, Conn.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Union Mfg. Co., New Britain, Conn.
Whitman & Barnes Mfg. Co., Chicago, Ill.
Whitney Mfg. Co., Hartford, Conn.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe

Cincinnati Chuck Co., Cincinnati, O.
Cushman Chuck Co., Hartford, Conn.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.